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ERRATA.

Vol. 58, p. 287, second line. *For* "$\frac{1}{4}\frac{b}{L^2}h$" *read* "$\frac{1}{4}\frac{b^2}{L^2}h$."

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Notes on Meteorology and the Navigation of Airships

BY M. A. GIBLETT, M.Sc.

1. *The loss of the "Dixmude."*

THE loss of the French airship "Dixmude" last December is to be deplored not only on account of the loss of gallant lives, but because it will inevitably add to the difficulties of the promoters of the Imperial airship service in securing the public confidence and a sympathetic attitude towards airship development, however little the individual case may really bear on the general question. No official report has yet been published, but, from accounts in the press, it seems that the weather is under suspicion, and, accordingly, a description of the meteorological conditions may prove of interest.

It appears that the airship left Toulon at 5 a.m., December 18th, setting out for a long cruise to North Africa. At this time the weather situation was determined by a large anti-cyclone stretching from Iceland to the Azores with an extension over France; pressure was low over central and northern Europe and rather uniform over the western Mediterranean. The next day or two saw the nose of high pressure over France give way and the Mediterranean invaded by a strong, cold wind current pouring through the gap between the Alps and the Pyrenees and sweeping round a depression which developed rapidly over the Adriatic.

Such was the situation when, on the evening of December 20th, the airship last signalled her position not far from Biskra (Algeria).

Wt 69—P 1 1000 2/24 M.&C.

A simple acknowledgment of a wireless signal is said to have been obtained at 2 a.m. the next morning but nothing more was heard. The body of the Commander was recovered from the sea off Sciacca, south-west Sicily, some days later, and fragments of charred wreckage were also found in the same region.

The depression had reached its full intensity by the morning of the 21st, when it was centred over southern Italy, and in steering, or perhaps drifting, from the land to the sea off Tunisia, the airship actually passed towards the centre of the disturbance. High winds do not, however, constitute a danger to an airship in the air, but conditions were squally and thundery. The air which entered the Mediterranean was of Arctic origin, and, in a region with a normal sea surface temperature above 60° F., there was a good chance of thunderstorms of the " polar air " type* which are not unusual on the north-west coasts of the British Isles.

It may be assumed that the airship was lost on the 21st, some 150 miles WNW (*i.e.* up-wind) from Malta, and the following observations at Malta probably represent the conditions encountered by the ship.

	18h.to 7h.G.M.T.		At 7h G.M.T.			7h. to 18h. G.M.T.		At 18h. G.M.T.			
Date	Weather	Rain	Temp.	Wind	Weather	Weather	Rain	Temp.	Wind	Weather	Highest Gust
Dec.		mm	°F				mm	°F			m.p.h
20	c	—	57	W3	c	bc	—	57	WSW2	bc	28
21	bcr	2·5	49	WNW4	bc	rtlr th	4·5	45	W3	op	39
22	rtlr th	13·9	46	WNW5	roh	ortlr ts	10·2	45	NNW6	c	46
23	cr	1·0	53	NW'W3	o	bc	—	57	WNW3	c	28

The snow reported was light.

UPPER WINDS

	20th. 17h G.M.T.		21st. 7h G.M.T.		21st. 17h G.M.T.	
		m.p.h.		m.p.h.		m.p.h.
1000 feet	240°	18	270°	45	310°	33
2000 feet	240°	20	270°	53	—	—
3000 feet	250°	17	270°	60	310°	34

Direction is in degrees from North through East.

The "*Daily Telegraph*" of February 1st, stated that the Ministry of Marine had received a report from the Commission of Enquiry. The main contents were given on the authority of the "*Matin*," but as the report has not officially been made public perhaps these should be accepted with reserve. The commission is alleged to have agreed unanimously that the immediate cause of the disaster was that the airship was struck by lightning, and to have found that the meteorological service at the airship base was perfect.

The importance of meteorological factors was discussed from the airship pilot's standpoint by Major G. H. Scott† in 1921. Electrical storms are cited by him as a source of danger to rigid airships, not so much because of lightning as on account of the risk of the violent associated air movement severely stressing the structure. The loss of three balloons in the Gordon Bennett Race last year amply demonstrated the possibility of their being destroyed by lightning, but the event seems to have been rare in the history of ballooning, and, further, airships have been known to have been struck without serious effects. It is to be hoped that some protective device will be invented before long.

2. *Wind and Airship Navigation.*

In Major Scott's paper on *Airship Piloting* he emphasized the point that the pilot should vary his route in accordance with the information which he would receive by wireless telegraphy as to the wind distribution. The present writer was led to consider such problems by a suggestion from Lieut. Col. Gold that Francis Galton's "Isodic Curves,"‡ devised years ago in connection with the choice of the best routes for sailing vessels, might find an application to the new form of travel. A geometrical method was readily found for investigating the quickest route from point to point for an airship cruising with constant air-speed. The method is illustrated by the diagrams. In the inset diagram, A represents the starting point of the airship, AO, the distance the ship would drift with the wind in a small interval, say 2 hours, without the engines running, and OB, the distance the airship would cover in still air if headed in this direction with the chosen cruising speed. Under the combined influence of wind and propellers, the path of the ship

* When cold air is being heated from below, vigorous convection is to be expected, *vide* "On the formation of thunderstorms over the British Isles in Winter," by E. V. Newnham, London Met. Office Professional Notes, No. 29.

† "Airship Piloting" by Major G. H. Scott. *Aeronautical Journal*, February, 1921.

‡ *Report of the British Association for the Advancement of Science*, 1866, Miscellaneous communications to the sections, p. 17; and *Minutes of the Proceedings of the Meteorological Committee*, November 25th, 1872, and December 2nd, 1872.

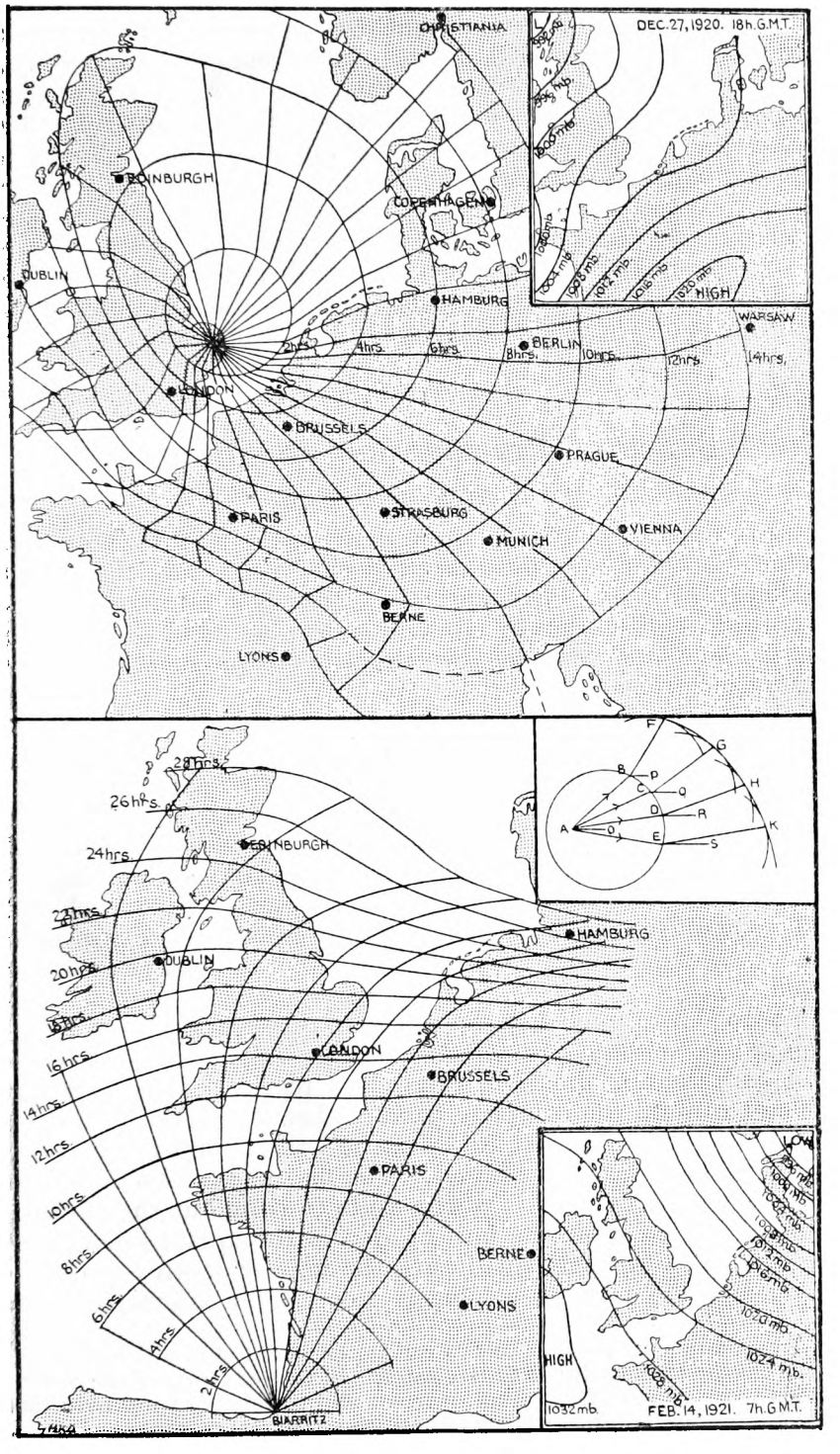
would be AB. Heading in other directions, points C, D, E, etc., could be reached, but not passed, in the given time ; B, C, D, E, etc., lie on a circle with centre O. The construction may be repeated taking each point B, C, D, E, etc., in succession as point of departure of the airship, using the wind velocities appropriate to the new places and time. P, Q, R, S, etc., are the centres of the new circles, which, for a constant air-speed are of equal radius to the first. The outer envelope of these circles is then drawn touching them at F, G, H, K, etc., the resulting curve being one which could be reached from A, but not passed, in the double interval, 4 hours, by the routes ABF, ACG, etc. Any other route would result in a failure to reach the curve in 4 hours. The construction may be repeated again, starting with F, G, H, K, etc., and so on, certain steps being taken to avoid accumulating errors.

The two larger diagrams show the application to particular cases, the airship being supposed to fly with air-speed 50 m.p.h., and at an altitude of 2000 feet so that the wind may be taken as the " geostrophic wind." The first shows a set of " quickest routes " emanating from Pulham (Norfolk), leaving at 7h. G.M.T., December 27th, 1920. The isobaric chart for 18h. G.M.T., December 27th, alone is reproduced, but changes with time were allowed for. With the particular air-speed, Paris could not have been reached under 10 hours, whereas a route could have been found reaching Warsaw in just over 14 hours. The second example shows a set of " quickest routes " leaving Biarritz at 17h. G.M.T., on February 13th, 1921. The bending of the routes on approaching the Scandinavian depression may be noted, the quickest route to Hamburg, 26 hours, passing near London. When the wind is uniform the quickest route from one point to another is the straight one, curvature only arising when there is a change of wind in a horizontal direction (or in time).

The construction is the same as is used when Huyghens's Principle is applied to the advance of a wave-front in a moving medium, so that the mathematical treatment of the propagation of sound in the atmosphere* might find an application in the present connection. The air-speed of the ship is analogous to the speed of sound, the " quickest routes " to sound rays, and the curves reached in given intervals of time to the wave-fronts. But an extension is required for the case of time-variations in the wind distribution which are unimportant in the acoustical problem on account of the relatively great speed of sound.

An " isodic curve " in Galton's work corresponded to the first circle in the above construction, and showed an eight hours run of a sailing vessel in each direction from a given point under average

* *Vide e.g.* E. A. Milne's article on Sound Waves in the Atmosphere in *Phil. Mag.* Vol. xlii., July, 1921, p. 96.



HIGHWAYS OF THE AIR.

conditions of current and wind, but it was not circular, since the speed of the ship depended on its course relative to the wind. One such curve was constructed in each two-degree square of the chart, and a geometrical method proposed for comparing the time, under average conditions, along any two routes. Such a method might certainly be applied in choosing the best airship route for average conditions, but for regions with variable winds the method we have been discussing is probably better. It is not suggested that the construction, which is tedious, could be done in this form on every occasion, but, if worked out once and for all for typical cases it might yield results of value.

The Balance of Precipitation and Evaporation by Land and Sea

THE first draft of a balance sheet showing the relation between precipitation and evaporation over the globe was made by Brückner[1] in 1905. Brückner used Murray's estimate of the amount of water carried by rivers into the sea and of the rainfall over the land, and made his own estimates of the most probable evaporation from the sea.

In 1906 Fritzsche[2], a pupil of Brückner's, worked over Murray's ground, taking later estimates of the flow of individual rivers, and using Supan's map of the rainfall over the land surfaces in place of Loomis's. From his study of the rivers, Fritzsche adopted 30 per cent. as the fraction of its rainfall that runs off the peripheral land, *i.e.* off the part of the land that drains to the open sea. For the remainder, which we may call aperipheral land, evaporation and rainfall must be equal. In Fritzsche's balance sheet Brückner's estimate of evaporation at sea is preserved.

In 1920 Wüst[3] published the results of observations of evaporation at sea,* revised Brückner's estimate of the average evaporation and thereby modified Fritzsche's results. Wüst's paper does not contain the complete balance sheet, however, and it is left to the reader to refer to Fritzsche's thesis and reconstruct such a balance sheet for himself. The matter is of such importance, however, that it is worth while to copy out the figures. In the following table the unit of area is 10^8 square kilometres (the square on an earth-quadrant), the unit of depth is a centimetre, and the unit of volume is 1,000 cubic kilometres. It

* Evaporation from small vessels carried on board ship was estimated by the change in the saltness of the water. In the reduction of the observations the strength of the wind over sea and of relative wind over the vessels was allowed for as well as temperature differences, etc.

will be noticed that if the average rainfall over 10^8 square kilometres is one centimetre, the volume of water is 1,000 cubic kilometres. The fundamental data are shown in heavy type, all with the exception of the 82 cm. for evaporation over the sea, coming from Fritzsche's paper. The other figures are obtained by mere arithmetic. It is remarkable that the average rainfall for the whole globe is estimated as practically the same as the average for the sea alone. It is a little below the average for England which is 80 cm.

		Area	Annual Depth	Annual Volume
Unit		10^8 km^2	cm	10^3 km^3
Aperipheral Land	Rainfall (Fritzsche)	**0·32**	**33**	10·5
	Evaporation.	0·32	33	10·5
Peripheral Land	Rainfall (Fritzsche)	**1·17**	**87**	101·5
	Run-off=**30**% (do.)	1·17	26	30·5
	Evaporation=70%	1·17	61	71·0
The Sea	Evaporation (Wüst)	**3·61**	**82**	296·0
	Run-in (from land)	3·61	8·5	30·5
	Rainfall	3·61	73·5	265·5
The Globe	Rainfall	5·10	74	377·5
	Evaporation	5·10	74	377·5

The researches of Fritzsche and Wüst do not furnish direct information as to the distribution of rainfall over the sea. The only meteorologist who has charted the rainfall of the oceans is Supan.[4] Supan's chart was utilised by Herbertson in the preparation of Plate 18 of Bartholomew's Atlas of Meteorology.[5] The data at Supan's disposal were very scanty. He relied largely on the observations collected by an English author, W. G. Black,[6] rain-gauge observations made on various ships in the years 1864 to 1881. In view of the acknowledged difficulty of measuring rainfall at sea no very high order of accuracy can be expected in the charts even for the limited areas which they cover. Nevertheless an attempt has been made to utilize them for assessing the average rainfall over the sea. Kerner[7], who carried out this investigation, found that the average rainfall over the sea was about 100 cm., Wüst compares this amount with that given in the foregoing balance sheet and comes to the conclusion that Kerner's estimates for the rainfall in different latitudes should be reduced by one quarter. This conclusion is supported by a discussion of the salinity of the ocean.

The moral seems to be that the rainfall shown on Supan's

charts and therefore on Herbertson's must be discounted somewhat. All the authors agree in urging the desirability of organized observations of rainfall at sea. In this branch of practical meteorology there has been little progress since 1864.

Another paper on the subject was published by Wüst in 1922. In this paper balance sheets are given. These are not quite in accordance with the earlier paper: Fritzsche's estimate of the continental evaporation is considerably reduced and, on the other hand, Wüst's own estimate of evaporation over the sea is increased.

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NOTE.—Wüst's papers contain full references to other work on the subject.

Discussions at the Meteorological Office

January 21st, 1924. *The auroral spectrum and the upper strata of the atmosphere*, and *The constitution of the upper strata of the atmosphere*. By L. Vegard (Phil. Mag. XLVI., 1923). *Opener*—C. E. Britton, B.Sc.

Some account of these papers has been given in the *Meteorological Magazine, vide* Recent Researches on the Constituents of the Upper Atmosphere, by M. T. Spence. Vol. 58, p. 223.

* See also *Meteorological Magazine*, vol. 57, Feb., 1922, p. 8, for discussion on this paper.

February 4th, 1924. *A statistical study of surface and upper air conditions in cyclones and anti-cyclones passing over Davenport, Iowa.* By A. D. Udden (Monthly Weather Review, February, 1923). *Opener*—Capt. J. Durward, M.A.

Critics often allege that meteorologists accumulate observations but spend too little time in analysing the observations in such a way that they will prove useful in correlating local weather with the variations in atmospheric circulation. The author of the paper under discussion takes up this challenge and finds what wind, cloud and temperature occur on the average when Davenport is, for example, to the south of the centre of a depression and between 100 and 400 miles from the centre. The results are set out in a series of telling diagrams. One of the more striking conclusions is that the meteorological situation most productive of rain is a depression centred due south of Davenport, but that even then the odds against rain at any instant are 2 to 1. When a depression is to the north-east of Davenport, and within 400 miles, the odds against rain at any instant are 8 to 1. The discussion of the movement of the upper clouds shows that the general drift is hardly correlated at all with the winds near the ground. The drift is steady from the west across a cyclone, from west north west across an anti-cyclone. The paper provided material for a good discussion. Criticism was directed to the pooling of data for all seasons of the year and to the division of a cyclone into sectors which had no reference to the direction of motion. The temptation to regard the results as applicable to the distribution of weather round the pressure centres instead of as data for Davenport was found to be very strong. The temptation will not be overcome until many studies of the kind are available. Perhaps the energetic co-operation of the Weather Bureau officials will make this possible in the near future.

THE subjects for discussion for the next two meetings will be:

February 18th, 1924. *On the nature of atmospherics* by R. A. Watson Watt and E. V. Appleton (Proc. Roy. Soc., Vol. 103, 1923, p. 84). *Opener*—G. I. Taylor, F.R.S.

March 3rd, 1924. *Der tägliche Gang der Temperatur in der freien Atmosphäre über Lindenberg*, by H. Hergesell (Braunschweig, Die Arb. der Preuss. Aero. Obs. bei Lindenberg, XIV Band). *Opener*—Capt. D. Brunt, M.A., B.Sc.

The Cart before the Horse.—A member on the debate on the Address in the House of Commons: "There was no thunder or lightning and consequently no storm." *New Leader*, January 18th, 1924.

Royal Meteorological Society

THE annual general meeting of this society was held on Wednesday, January 16th, at 49, Cromwell Road, South Kensington, Dr. C. Chree, F.R.S., President, in the Chair. The report of the council for 1923 was read and adopted and the council for 1924 duly elected, the new President being Mr. C. J. P. Cave, M.A., J.P.

The Symons Gold Medal awarded to Prof. Takematsu Okada, Director of the Central Meteorological Observatory, Tokyo, was accepted on his behalf by His Excellency the Japanese Ambassador.

By the adoption of the report of the Council the proposed institution of a Buchan Prize was approved. This prize will suitably commemorate Dr. Alexander Buchan, the distinguished secretary of the Scottish Meteorological Society whose researches on the climatology of the globe were marked by so much originality and perseverance. The prize is to be awarded biennially to the author of the paper in the Journal of the Society which is adjudged by the Council to be of the highest merit as a contribution to meteorology.

The retiring President, Dr. C. Chree, delivered an address on "Reflections on various subjects including meteorology and sunspots."

The most striking feature of the address was an analysis of certain of the meteorological observations at Kew Observatory with reference to the sunspot cycle. In waggish mood Dr. Chree showed how by skilful selection of the statistics diametrically opposite conclusions could be reached. In his concluding remarks he threw out the suggestion that a study of the weather on days which are magnetically "quiet" or "highly disturbed" should provide the answer to the question whether magnetic disturbances affected the terrestrial atmosphere, and this without waiting for the passage of many sunspot cycles.

Correspondence

To the Editor, *The Meteorological Magazine*

Wind Suction in Lighthouses

THE notes on the above subject (pp. 135 and 285 of vol. 58 1923) have been of peculiar interest to me, because I believe I am right in saying that I originated the method of investigation

which has definitely settled the question. That barometer readings at lighthouses were "shaky" had long been more than suspected, and Dr. Buchan and others had concluded that the defects were due to the eddying of the wind at headlands, such as Dungeness. If I remember rightly the lighthouse itself was not suspected to be the cause.

When I became forecaster and inspector, the problem naturally appealed to me, for in the preparation of the synchronous charts the isobars in the vicinity of lighthouses were almost invariably distorted, without any corresponding irregularity in the wind. My own view was that the faulty readings were due to up-draughts and downdraughts in the tall structures—the entrance door at the base open or shut, and the lantern at the summit shut or open to windward or to leeward. I was influenced by this idea when, on superintending the transfer of the meteorological instruments from the old Portland lighthouse on the crest of the hill to the new building practically at sea level close to the Bill, I had the barometer suspended in a recess under the stone stairs at the base. On a subsequent inspection visit I had a number of readings taken under varying conditions, and the results were noted in my report.

But tests at Malin Head on my visit in 1911 were more interesting because the Coastguard watch tower there is not a tall lighthouse structure, but a squat square building of two floors, with a trap door access to the roof, the barometer being suspended in the upstairs room, window facing north. I had the entrance door, the room door, the trap door, and the window opened and shut, and at each operation the ratings in attendance and myself took independent readings of the barometer; in every instance a separate setting of the vernier, and to prevent any possibility of influencing each other we wrote down our readings. A light W.N.W. breeze, force 3, was blowing, and I was surprised that, with such a feeble movement, there was to the unaided eye a perceptible and instantaneous rise or fall of the mercury, which every one of our readings showed to amount to 0.012 in., or 0.4 mb.

This result afforded the explanation of the violent oscillations of pressure shown in the Malin Head barograms whenever high winds prevail, the oscillations exceeding 0·1 in. or 3·4 mb. in severe gales. Before the explanation was known, small secondary cyclones were shown in the isobars over Donegal which had no other existence than in that tiny room on Malin Head.

HY. HARRIES.

10, *Tennis Road, Hove, January 29th*, 1924.

On the Effect of Radiation on the Grass Minimum Thermometer

DURING the winter of 1922-1923 a set of comparisons were made at Benson Observatory, between the grass minimum thermometer and an aspiration psychrometer. The object of the test was to discover if possible how far low readings on the grass are due to direct radiation from the bulb of the thermometer to the sky. To this end the grass minimum was exposed in the normal manner with the bulb about an inch above short grass and was unprotected in any way. The aspiration psychrometer was hung vertically a few feet away on the same grass plot with the air inlet at the same height above the grass as the thermometer bulb. The observations were made on some 12 cold mornings, just before or at about sunrise, and took the form of simultaneous readings made at intervals of a few minutes over periods of about 20 minutes, more or less. The weather conditions were calm or nearly so, and the sky in general clear or not more than half covered. The observations were in general stopped when the effect of the rising sun became appreciable. All the readings taken in the group were meaned.

It was found that after correcting for difference in index error of the two thermometers the grass minimum invariably read lower than the psychrometer, the amount of the difference increasing with falling temperature. A range of from 16° F. to 32° F. approx. was investigated and a rough linear relationship established as follows :—

Grass Minimum. ...	32·0 F.	24·5 F.	17·0 F.
Psychrometer. ...	33·0	26·5	20·0

The individual groups of observations showed some scatter when plotted, but the above law summarises the general result fairly well. At the times the comparisons were made it may be taken that the screen thermometer was on the average about 6° F. above the grass minimum thermometer.

On one occasion at a temperature of 16° F. the psychrometer was also compared by laying it flat on the grass so that the air was drawn in from below the bulb of the grass minimum. It still read higher than the latter by 1·7° F. as against 2·8° F. when hung up for a normal test.

The whole comparison indicates that in clear calm weather the grass minimum thermometer is considerably affected by direct radiation, and that the air round about it in such case is at an appreciably higher temperature than is indicated by the thermometer.

L. H. G. DINES.

Kew Observatory, November 15th, 1923.

Two Hints for Rainfall Observers

MY 5 in. gauge was sold to me with a certificate of accuracy, and I took great care to see that the top was level when it was placed in position; but, although it was fixed in the ground as firmly as I could fix it without putting it into a concrete bed, I frequently found afterwards that it required relevelling. This happened so often that I began to think that some movement in the soil, such as might be caused by the growth of an extra strong grass or weed root, must be the cause of the trouble, and that, to prevent it, a very considerable bed of concrete would be required. But, early this year, I found that the trouble was due to the fact that the knife-edged ring was not absolutely parallel with the part of the funnel which rests on the lower half of the gauge, the part that is fixed in the ground. The result was that, however carefully it was levelled when last set, it would be off the level if replaced partly turned round. When I found this out, I painted a black straight line down the outside of the gauge to ensure that the funnel would always be put back in the same position. Since then my trouble has ceased. I have tested the gauge repeatedly since then, and have never found it off the level; but, if I turn the funnel through 180° the edge is 46′ of angle off the level.

I suggest that new gauges if they are not now all tested for this defect should be issued with a vertical black line on both halves, and that observers should be warned to do the levelling with the two halves of the line coinciding and to be careful always to replace the funnel in the same position. With this defect in a gauge, setting the gauge in a concrete block would be apt to prove a trap. If mine had been placed in concrete and carefully levelled, I should, in all probability, never have again tested it to see if it were still in truth and it would have been off the level far more often than not.

Another hint that would probably be of use to many observers is that smearing with vaseline the surfaces of the upper and lower halves of the gauge, where they overlap each other, prevents them from sticking together in frosty weather. Until I found this out I had almost always to relevel the gauge after removing the funnel in frosty weather, and once or twice I had to bring the whole gauge into the house to thaw it. An application of vaseline entirely removed the trouble, and, although made a year ago, has not yet had to be repeated.

T. E. LANDER.

Auchtyfardle, Lesmahagow, Lanarkshire, January 1st, 1924.

NOTES AND QUERIES

A Course of Training for Observers

IT is proposed to hold the second course of training for meteorological observers, to which reference was made in the September 1923 issue of this magazine, at Kew Observatory, Richmond, Surrey, during the week April 28th to May 3rd, 1924, both dates inclusive.

The subjects to be dealt with will include the following:—

Meteorological instruments and method of Observation.
Recording of Observations and their transmission to the Meteorological Office.
The Weather Map; charting of observations received from stations by telegraph.
Climatology.

The course is addressed primarily to observers at stations which report regularly to the Meteorological Office, especially those at health resorts. Provided the accommodation is adequate, others will, however, be admitted, at the discretion of the Director. Applications for tickets of admission should be made to the Director, Meteorological Office, Air Ministry, Kingsway, W.C. 2. There will be no fee for the course.

Weather Insurance for Farmers

AMONGST the subjects discussed by the Commission for Agricultural Meteorology at the recent Meeting at Utrecht was a principle propounded by Mr. R. A. Fisher, of Rothamsted, that in the collection of statistics the possible application to insurance problems should be the first consideration.

With an insurance policy of the type that Mr. Fisher has in mind a farmer would be entitled to compensation if such weather occurred as would presumably ruin his crop. It would not be necessary for him to prove that it had been ruined. The criterion would be arrived at by the study of the statistics for previous years. For example a drought in spring is known to be very bad for the hay crop. Statistical studies will show which are the weeks of the most importance in any particular part of the country, and the farmer will be able to insure against an absence of rain during those particular weeks. In this particular instance, the statistical material is available already and there would be no great difficulty in arriving at equitable rates of insurance. In general the problem is much more difficult, but the mere effort to state it explicitly is bound to have a steadying influence

and should help to define what information about the crops must be collected and collated. It is futile to deplore the little interest taken by farmers in meteorological statistics unless we can assert with conviction that the statistics have a direct application to practical farming.

Readers who are interested in this subject should refer to the article on *Weather Insurance* by Dr. A. H. Palmer in the October issue of Tycos-Rochester. The following is a short extract from this article—"The recent tendency in crop insurance has been towards a blanket policy covering all risks. If the farmer had to take out separate policies against hail, frost, drought, floods, desiccating winds, field fires, insect pests, etc, he would have little margin for profit In most cases a banker advances the insurance premium for the farmer, and naturally he it is who insists upon a single policy to cover all possible risks While no such ideal blanket insurance policy is yet available, progress has been made in the direction of its attainment.

The Chilly South!

THE following paragraph is from an interesting account of the first journey ever made by motor car across the Sahara between Tuggurt (south of Biskra in Algeria) and Tozeur (at the great oasis of El Jerid) in Tunisia. The route is in no part more than a few hundred feet above sea level.

> "Eleven hours—ten hours, even—at this season of the year are too much. There are not so many hours of daylight. And it is cold; bitterly cold before sunrise and after sunset, and cold all day. Whatever it may be in summer, and though the sun shines brightly from morning till evening, the North African desert at this time of year is a cold region. Even when out of the wind there is always, in spite of sunshine, a chill in the air: and in mid-afternoon after the sun has beaten on it steadily for five or six hours, if you put your hand on the sand it is still as if it were iced. Camels, date palms, dry thorn bushes, and the thirsty Sahara—they do not conjure up images of cold: but any one who motors over the desert in December or January will need his thickest underclothing, a heavy greatcoat and warm muffler—and still he will be cold." "*The Times*," January 11th, 1924.

Meteorologists would like to have more information as to the cold sand. According to Angot* the range of air temperature in January in the Algerian Sahara is about 22° F. (and this implies strong heating of the air by the sand). It would have been of interest to get actual measurements of the temperature of the surface layers.

* Quoted by Hann, Klimatologie III., 68 (3rd Ed. 1911).

Radiation from the Sky

RADIATION MEASURED AT BENSON, OXON, 1923.

Unit: one gramme calorie per square centimetre per day.

ATMOSPHERIC RADIATION only (dark heat rays).

Averages for Readings about time of Sunset.

		Oct.	Nov.	Dec.
Cloudless days:				
Number of readings	n	7	7	8
Radiation from sky in zenith ...	π I	481	424	419
Total radiation from sky ...	J	519	454	448
Total radiation from horizontal black surface on earth ...	X	698	632	628
Net radiation from earth ...	X—J	179	178	180

DIFFUSE SOLAR RADIATION (luminous rays).

Averages for Readings between 9 h. and 15 h. G.M.T.

Cloudless days:—				
Number of readings	n_0	3	4	4
Radiation from sky in zenith ...	πI_0	21	21	15
Total radiation from sky ...	J_0	34	27	21
Cloudy days:—				
Number of readings	n_1	7	3	6
Radiation from sky in zenith ...	πI_1	73	22	23
Total radiation from sky ...	J_1	63	19	20

Unit for I = gramme calorie per day per steradian per square centimetre.
Unit for J and X = gramme calorie per day per square centimetre.
For description of instrument and methods of observation, see *The Meteorological Magazine*, October, 1920, and May, 1921.

The Long Arm of Coincidence

FOR two stations in Wiltshire the observers have reported that the rainfall for 1923 was exactly the same as for 1922. These are Market Lavington, Wilts (Miss A. Pleydell Bouverie) 30.83 ins., and Tisbury, Wilts (Mr. J. Bristol) 43.61 ins.

Mr. B. Crosbie-Hill, of Leverton Manor, Hungerford, has also found for the rainfall exactly the same amount 29·79 inches in both years. He writes: "You will note in July, 1923, I was away for a considerable time, and consequently could only measure what rain there was in my gauge on my return, adding thereto a little for evaporation. . . . Until I came to add my 1923 figures I was not aware the two years were going to be even very close. . . . Is not my experience unique?"

The Growth of the Daily Weather Map

THE announcement by the Central Physical Observatory, Petrograd, of some changes in the reports issued by wireless telegraphy marks an important step towards the construction of daily weather charts of the Northern Hemisphere. The observations are now issued more promptly than formerly; a message broadcasted at 9h. 15m. G.M.T. contains observations taken at 7h. G.M.T. the same morning, and supplementary observations are issued in a later message at 11h. G.M.T. The network of stations included is extended to Siberia and comprises 73 places ranging from Petrograd and Odessa to Vladivostock.

This issue has already rendered it possible for charts extending three-quarters of the way round the hemisphere to be constructed in the Meteorological Office before noon of the day of observation. If it were now possible to "pick up" the Japanese wireless reports and observations from ships in the Pacific the hemisphere would be completely encircled.

Review

The Mechanical Properties of Fluids. 8vo., $8\frac{3}{4} \times 6$, pp. xiv.+ 362. *Illus.* Blackie & Son, Ltd. 20s net.

THE time is opportune for the publication of a book on "The Mechanical Properties of Fluids," and Messrs. Blackie have been fortunate in obtaining the assistance of the experts who contribute the several articles to the work which they publish under that title.

The articles have been written independently, but they do not overlap very much; in fact it might be urged that there should have been more cross-references from one article to another. There is one conspicuous example of such a lost opportunity. In the article on Hydrodynamical Resistance, Prof. A. H. Gibson gives the relation between the drag exerted on a board by an air current passing over it. In the article on "Wind Structure," Dr. Geddes states the formula for the resistance which is offered to the wind as it blows over the countryside. Neither author quotes Taylor's remark that the small scale and large scale observations are in excellent agreement nor mentions that the generalization has been extended to the action of tidal currents on the sea bottom. The subject of tidal currents is curiously enough omitted from the book entirely.

Mr. Taylor's contribution to the book is an account of the determination of the mechanical properties of shafting by the study of soap-films, an achievement which must fascinate every reader. It was a disappointment, however, to find that he had not anything to say about fluid motion in its various aspects. We can but mention the articles by Dr. Allan Ferguson on "Liquids and Gases," by Professor Lamb on the "Mathematical

Theory of Fluid Motion," by Mr. Mitchell on " Viscosity and Lubrication," by Dr. Drysdale on " Submarine Signalling," and by Mr. F. H. W. Hunt on the " Reaction of the air to Artillery Projectiles." We are more concerned as meteorologists with Dr. Geddes's article on " Wind Structure." Dr. Geddes disarms criticism by his concluding remark, "in this brief study some only of the intricacies of the problems of wind structure rather than their solutions, have been placed before the reader." This may be regarded perhaps as a confession that an attempt has been made to cover too wide a field. We are inclined to agree that that is the case. The range of the article is very much the same as that of the one published part of Shaw's Manual of Meteorology (Part IV.), and the substance of that work is compressed into 39 pages.

Attention may be called to one or two cases in which Dr. Geddes seems to us to have fallen into error as he sins in good company. A demonstration of the rule for finding the deflective " force " due to the rotation of the earth is given at considerable length, but it purports to apply to motion on the surface of a spherical globe. Is it necessary to point out that the fact that the level surfaces on the earth are spheroidal should be mentioned explicitly in any proof of the rule in question ? The rule does not hold for a spherical globe. Again, the characteristic equation for the propagation of momentum in an eddying fluid is quoted (Eq. 5, p. 265) without the geostrophic term. The integral of the equation with that term included is the basis of the whole of the following argument, and, as the reader is credited with sufficient mathematical knowledge, the integral should certainly have been set out. Geddes does not seem to have realized that the gradual approach of the actual wind to the " gradient wind " occurs even on the hypothesis of uniform turbulence. The statement " As we ascend above the surface a nearer approach is made to the geostrophic values, largely due to the fact that turbulence tends to diminish with height, its influence being on an average very little felt at 1,000 metres " is misleading.

There are other matters concerning which Dr. Geddes's treatment does not strike us as quite sound but they cannot be dealt with in a short review. The great merit of his article is that it is likely to widen the circle of readers who make a serious study of the mechanics of the atmosphere.

News in Brief

Mr. O. F. T. Roberts, B.A., M.C., Professional Assistant at Porton, has been appointed Cruickshank Lecturer in Astronomy and Meteorology at Aberdeen. Mr. Roberts joined the staff of the Meteorological Office in February, 1921, and was immediately seconded for duty at Porton, where he has devoted some

time to researches on the form of smoke clouds in a turbulent atmosphere. Some of his results are published in a paper in Proceedings Royal Society, December, 1923.

A course of five lectures* on Meteorological Optics will be given by Mr. F. J. W. Whipple, at the Royal College of Science, on Monday afternoons, at 3.30 p.m., beginning on Monday, February 18th. The lectures will be illustrated by experiments.

At the Annual Meeting of the Physical Society of London, on Friday, February 8th, the first Duddell Medal was presented to Professor Hugh Callendar. The Medal, which commemorates the inventor of the Oscillograph, is to be awarded to an inventor of scientific instruments of the highest merit. Meteorologists who are famiilar with Callendar's thermograph and radiograph will applaud the choice of the first medallist.

At the recent Exhibition of the Royal Photographic Society, Mr. G. A. Clarke showed several cloud photographs. For one of these, an autochrome slide, representing a sheet of strato-nimbus cloud 20 minutes after sunset, a medal was awarded.

The fifth Meteorological Office Soirée, held on February 8th, 1924, at Australia House, was attended by more than 200 past and present members of the Office Staff and their friends, and a varied programme of music and dancing was provided. Among those present were Sir Napier Shaw, Col. Lyons and Dr. and Mrs. Simpson.

The third Annual Dinner of The Meteorological Office Staff at Shoeburyness, was held at the Queen's Hotel, Westcliff, on January 19th, 1924. The guest of the evening was Capt. D. Brunt, Superintendent of Army Services, and Mr. C. E. Britton was in the chair.

We have received Vol. 1, No. II., of " Rainfall in the Southern Pennines," the organ of the Manchester and Stockport Rainfall Organization. This issue contains the annual summary for the year 1920, compiled by Mr. A. A. Barnes. In addition to the 1920 statistics there is a table showing the rainfall for each year since 1865 at eight places situated in Lancashire and Yorkshire. These tables should be very useful to meteorologists interested in long series of records of weather.

The upper air observations made at Soesterberg, the Dutch aerodrome, have appeared with great regularity in the Upper Air Supplement of the Daily Weather Report in recent years. It is of interest to learn from the official report on the observations for 1921 that during that year a subaltern named Bakkenes made no less than 313 ascents with the meteorograph. The most appropriate comment seems to be " For he's a jolly good fellow."

* *Vide Meteorological Magazine*, vol. 58, Sept., 1923, p. 180.

The Weather of January, 1924

THE first few days of the new year were mild with westerly winds and some rain, but the development of a belt of high pressure over the southern part of the North Sea and adjacent regions during the evening of the 3rd, caused a decided fall of temperature over the east and south-east of the British Isles. This was accompanied by thick fog in many parts of the country, including Ross-on-Wye, where the fog persisted throughout the day. After the 5th, when 55°F. was recorded at Killarney, the colder conditions spread also to the north and west, and temperature remained rather low for about a week. On the 8th a deep depression moving southeastwards over the Atlantic caused north-westerly gales of storm force (Beaufort force 10 and 11), some 800 miles westward of Scilly, and high south-easterly winds or gales in many parts of the British Isles. Snow fell generally on this and the two following days and in some places, including London (Hampstead), "snow lying" to a depth of between 5 and 6 inches was registered. The two coldest days of the month were the 9th and 17th, when at several stations, notably in the east and Midland counties, temperature did not rise above 32° F. all day. At one or two stations on the 9th, *e.g.* Nairn and Leafield, the maximum readings were as low as 27° F. or 28° F. The lowest screen minimum for the month, 11° F., occurred at West Linton on the 10th, and ground frosts were experienced on most nights during the month, among the lowest temperatures being 7° F. at Eskdalemuir on the 9th.

Between the 10th and the 17th there was a short period of mild unsettled weather, when a small depression over Ireland caused heavy rain in the west, 65mm. were recorded at Blaenau (Brecon), and 50 mm. at Rectory Dummanway (Cork) on the 12th, and 57mm. at Tairbull (Brecon) on the 11th. After the 17th, mild weather again set in with much rain at times, and this lasted until the last week of the month, when high pressure spread up from the south and fairer conditions obtained. Thunderstorms were reported at a few places in the South on the 19th.

The rise of the Seine which took place towards the close of December, 1923, continued into January, and at Paris the river reached a level of 24 feet above normal on the night of the 5th to 6th, after which it began to fall. Many streets were flooded, and about 5,000 persons had to leave their homes, while some 10,000 more suffered loss. On January 3rd, Cologne was threatened by Rhine floods, but the danger passed off. Over most of Europe the first half of January was characterised by cold and snowy weather. The Baltic coast of Denmark became ice-bound about the 2nd and shipping was more or less delayed throughout the month. On the 3rd, the ice was five inches thick on the

harbours and large steamers were frozen in. Early in the month Danzig was isolated by heavy snow, and railway traffic in Poland was seriously disorganized until the 5th. A report from Berlin, dated the 8th, reports heavy snow in north Germany and much damage by frost, snowstorms and sea-ice. The mouth of the Elbe was covered with floating ice, and there were "icebergs" two or three feet high in the Baltic. The month opened with very severe winter in Austria. In Switzerland the alternation of heavy snowfall with thaw and rain, referred to last month, continued for some days, causing further avalanches, but about the 5th weather conditions inproved, and remained good until the 22nd when there was a further thaw accompanied by rain. In Italy severe cold was reported on the 2nd, again on the 8th, when there was heavy snow in Lombardy, and at the end of the month, when there were deaths from cold at Florence. On the 7th there was a severe storm in Greece, followwed by intense cold. In Russia the end of December and the first week of January had very low temperatures, reaching —40° F. at Blagoveschensk in Siberia. In Finland —50° F. was reached at Sodankylä on the morning of the 22nd. There was a heavy gale at Biarritz on the 8th, and another storm off Portugal on the 14th, and the weather in the North Atlantic was stormy throughout the month.

In North America the weather was very cold. A severe cold wave visited the northern and eastern United States on the 5th. The temperature reached —15° F. as far south as St. Louis, —16° F. at Chicago, where twelve deaths from cold were reported, and —39° F. at Virginia, Minn. Another cold spell was experienced on the 21st, when the temperature fell to 4° F. at New York, and —28° F. further north. On the 27th the temperatures reached —60° F. in northern Ontario, after falling 64° F. in 36 hours.

The special message from Brazil states that in the central districts the rainfall was, on the average, 105 mm. above the normal, and disastrous floods occurred on the Parahyba River. In the northern and southern districts, however, the rainfall was scanty, being 51 mm. and 80 mm. respectively below the normal. Temperature continued one or two degrees above normal. The cane and cotton crops are in better condition in north Brazil and the wheat crop is plentiful. At Rio de Janeiro the mean pressure for the month was 1 mm. above normal, and the temperature 2 degrees below normal.

Rainfall January, 1924: General Distribution

England and Wales	128	per cent. of the average 1881-1915.
Scotland	101	
Ireland	148	
British Isles	125	

Rainfall: January, 1924: England and Wales.

CO.	STATION.	In.	mm.	Per-cent. of Av	CO.	STATION.	In.	mm.	Per-cent. of Av.
Lond.	Camden Square.....	2·75	70	148	*War*	Birminghm, Edgbaston	2·60	66	129
Sur .	Reigate, Hartswood...	2·66	68	118	*Leics*	Leicester Town Hall...	2·05	52	...
Kent.	Tenterden, View Tower	2·54	65	118	,, .	Belvoir Castle.....	1·91	49	108
,, .	Folkestone, Boro. San.	2·23	57	...	*Rut* .	Ridlington.....	2·23	57	...
,, .	Broadstairs	...	...	...	*Linc.*	Boston, Skirbeck	1·97	50	122
,, .	Sevenoaks, Speldhurst.	2·89	73	...	,, .	Lincoln, Sessions House	1·79	45	107
Sus .	Patching Farm.....	2·88	73	111	,, .	Skegness, Estate Office.	...	...	...
,, .	Eastbourne, Wilm. Sq.	2·30	59	87	,, .	Louth, Westgate	1·77	45	82
,, .	Tottingworth Park....	2·90	74	107	,, .	Brigg	2·17	55	121
Hants	Totland Bay, Aston...	2·85	72	123	*Notts.*	Worksop, Hodsock....	1·53	39	86
,, .	Fordingbridge, Oaklnds	4·32	110	157	*Derby*	Mickleover, Clyde Ho..	2·29	58	113
,, .	Portsmouth, Vic. Park.	2·67	68	112	,, .	Buxton, Devon. Hos...	4·40	112	98
,, .	Ovington Rectory	3·42	87	127	*Ches.*	Runcorn, Weston Pt...	2·70	69	114
,, .	Grayshott	3·21	81	119	,, .	Nantwich, Dorfold Hall	2·55	65	...
Berks	Wellington College...	2·76	70	139	*Lancs*	Bolton, Queen's Park .	3·75	95	...
,, .	Newbury, Greenham..	3·45	88	149	,, .	Stonyhurst College....	3·86	98	90
Herts.	Bennington House....	2·92	74	...	,, .	Southport, Hesketh...	2·73	69	107
Bucks	High Wycombe	3·04	77	145	,, .	Lancaster, Strathspey.	3·87	98	...
Oxf. .	Oxford, Mag. College..	3·41	87	198	*Yorks*	Sedbergh, Akay	4·91	125	89
Nor .	Pitsford, Sedgebrook..	2·12	54	114	,, .	Wath-upon-Dearne ...	1·47	37	77
,, .	Eye, Northolm.....	1·81	46	...	,, .	Bradford, Lister Pk...	2·64	67	92
Beds.	Woburn, Crawley Mill.	2·25	57	132	,, .	Oughtershaw Hall	5·70	145	...
Cam.	Cambridge, Bot. Gdns.	2·56	65	171	,, .	Wetherby, Ribston H..	2·18	55	106
Essex	Chelmsford, CountyLab	2·65	67	...	,, .	Hull, Pearson Park ...	1·96	50	109
,, .	Lexden, Hill House...	2·31	59	...	,, .	Holme-on-Spalding ...	2·26	57	...
Suff .	Hawkedon Rectory ...	2·59	66	149	,, .	Lowthorpe, The Elms.	2·37	60	115
,, .	Haughley House.....	2·22	56	...	,, .	West Witton, Ivy Ho..	2·91	74	...
Norf.	Beccles, Geldeston....	1·87	48	113	,, .	Pickering, Hungate ...	2·81	71	...
,, .	Norwich, Eaton	2·35	60	120	,, .	Middlesbrough	1·51	38	94
,, .	Blakeney	2·38	61	138	,, .	Baldersdale, Hury Res.	2·54	65	72
,, .	Swaffham	2·27	58	123	*Durh.*	Ushaw College	1·64	42	80
Wilts.	Devizes, Highclere....	4·13	105	189	*Nor* .	Newcastle, Town Moor.	2·06	52	101
Dor .	Evershot, Melbury Ho.	...	...	...	,, .	Bellingham Manor....	2·72	69	...
,, .	Weymouth, Westham..	4·68	119	193	,, .	Lilburn Tower Gdns...	1·92	49	...
,, .	Shaftesbury, Abbey Ho.	4·36	111	168	*Cumb*	Penrith, Newton Rigg..	...	...	...
Devon	Plymouth, The Hoe...	5·68	144	172	,, .	Carlisle, Scaleby Hall .	3·34	85	135
,, .	Polapit Tamar	5·70	145	153	,, .	Seathwaite	10·00	254	75
,, .	Ashburton, Druid Ho..	7·18	182	141	*Glam.*	Cardiff, Ely P. Stn....	5·91	150	156
,, .	Cullompton	4·91	125	152	,, .	Treherbert, Tynywaun	10·60	269	...
,, .	Sidmouth, Sidmount ..	4·27	108	149	*Carm*	Carmarthen Friary....	5·61	143	128
,, .	Filleigh, Castle Hill ...	6·24	159	...	,, .	Llanwrda, Dolaucothy.	7·11	181	134
,, .	Hartland Abbey.....	4·63	118	...	*Pemb*	Haverfordwest, Portf'd	7·10	180	154
Corn.	Redruth, Trewirgie ...	6·66	169	158	*Card.*	Gogerddan.....	...	...	...
,, .	Penzance, Morrab Gdn.	5·65	143	149	,, .	Cardigan, County Sch. .	4·89	124	...
,, .	St. Austell, Trevarna..	6·65	169	155	*Brec* .	Crickhowell, Talymaes	6·00	152	...
Soms	Chewton Mendip	4·95	126	129	*Rad* .	Birm. W. W. Tyrmynydd	6·23	158	99
,, .	Street, Hind Hayes	3·74	95	...	*Mont.*	Lake Vyrnwy	5·78	147	102
Glos..	Clifton College	4·98	127	175	*Denb.*	Llangynhafal	2·25	57	...
,, .	Cirencester	4·27	109	165	*Mer* .	Dolgelly, Bryntirion..	5·57	141	98
Here.	Ross, County Obsy. ...	3·84	98	159	*Carn.*	Llandudno	2·04	52	79
,, .	Ledbury, Underdown.	3·79	96	172	,, .	Snowdon, L. Llydaw 9	13·97	355	...
Salop	Church Stretton.....	2·73	69	108	*Ang* .	Holyhead, Salt Island.	4·81	122	165
,, .	Shifnal, Hatton Grange	2·76	70	142	,, .	Lligwy	4·14	105	...
Staff.	Tean, The Heath Ho...	3·17	81	123	*Isle of Man*				
Worc.	Ombersley, Holt Lock.	2·75	70	143		Douglas, Boro' Cem...	5·55	141	164
,, .	Blockley, Upton Wold.	3·77	96	160	*Guernsey*				
War	Farnborough.....	3·04	77	141		St. Peter Port, Grange .	4·28	109	146

Rainfall: January, 1924: Scotland and Ireland

CO.	STATION.	In.	mm.	Per-cent. of Av	CO.	STATION.	In.	mm	Per-cent. of Av.
Wigt.	Stoneykirk, Ardwell Ho	5·50	140	186	*Suth.*	Melvich School	2·47	63	75
,, .	Pt. William, Monreith .	5·49	139	...	*Caith*	Loch More, Achfary ...	7·68	195	105
Kirk.	Carsphairn, Shiel.	10·73	273	...	,, ..	Wick	1·96	50	80
,, .	Dumfries, Cargen	5·31	135	133	*Ork* .	Pomona, Deerness	3·04	77	88
Dum	Drumlanrig	5·55	141	134	*Shet* .	Lerwick	6·05	154	142
Roxb	Branxholme	3·38	86	123	*Cork.*	Caheragh Rectory	8·56	217	...
Selk .	Ettrick Manse	6·61	168	...	,, ..	Dunmanway Rectory.	10·17	258	163
Berk.	Marchmont House	2·49	63	111	,, ..	Ballinacurra	6·22	158	156
Hadd	North Berwick Res....	1·87	47	109	,, ..	Glanmire, Lota Lo. ...	7·94	202	185
Midl	Edinburgh, Roy. Obs..	2·07	53	118	*Kerry*	Valencia Obsy.	6·54	166	119
Lan .	Biggar	2·83	72	106	,, .	Gearahameen	12·00	305	...
Ayr .	Kilmarnock, Agric. C..	5·19	132	152	,, .	Killarney Asylum	6·45	164	109
,, .	Girvan, Pinmore	6·24	159	132	,, .	Darrynane Abbey	4·23	107	84
Renf.	Glasgow, Queen's Pk..	3·68	93	110	*Wat* .	Waterford, Brook Lo..	7·74	197	210
,, .	Greenock, Prospect H..	7·36	187	108	*Tip* .	Nenagh, Cas. Lough ...	4·86	123	123
Bute.	Rothesay, Ardencraig.	5·91	150	131	,, .	Tipperary	7·31	186	...
,, .	Dougarie Lodge	4·33	110	...	,, .	Cashel, Ballinamona ..	6·72	171	177
Arg .	Glen Etive	6·56	167	...	*Lim* .	Foynes, Coolnanes	3·93	100	104
,, .	Oban	5·82	148	...	,, .	Castleconnell Rec.	4·79	122	...
,, .	Poltalloch	5·61	143	112	*Clare*	Inagh, Mount Callan ..	5·87	149	...
,, .	Inveraray Castle	8·73	222	106	,, .	Broadford, Hurdlest'n.	4·71	120	...
,, .	Islay, Eallabus	5·70	145	122	*Wexf*	Newtownbarry	9·96	253	...
,, .	Mull, Benmore	13·60	345	...	,, .	Gorey, Courtown Ho...	7·71	196	247
Kinr.	Loch Leven Sluice	3·16	80	100	*Kilk.*	Kilkenny Castle	6·01	153	188
Perth	Loch Dhu	8·45	215	93	*Wic* .	Rathnew, Clonmannon	6·30	160	...
,, ..	Balquhidder, Stronvar.	6·30	160	74	*Cars.*	Hacketstown Rectory .	7·88	200	222
,, ..	Crieff, Strathearn Hyd.	3·89	99	97	*QCo.* .	Blandsfort House	6·11	155	186
,, ..	Blair Castle Gardens ..	2·57	65	...	,,	Mountmellick	4·47	113	...
,, .	Coupar Angus School..	2·47	63	104	*KCo.*	Birr Castle	3·95	100	139
Forf.	Dundee, E. Necropolis.	2·50	63	128	*Dubl.*	Dublin, FitzWm. Sq...	3·46	88	151
,, .	Pearsie House	4·05	103	...	,, .	Balbriggan, Ardgillan .	3·96	101	173
,, .	Montrose, Sunnyside ..	2·59	66	130	*Me'th*	Drogheda, Mornington	3·66	93	...
Aber.	Braemar Bank	2·09	53	68	*W.M*	Mullingar, Belvedere .	4·34	110	135
,, .	Logie Coldstone Sch. ..	1·43	36	65	*Long*	Castle Forbes Gdns....	4·22	107	127
,, .	Aberdeen, Cranford Ho	2·21	56	93	*Gal* .	Galway, Waterdale ...	3·39	86	...
,, .	Fyvie Castle	2·20	56	...	*Mayo*	Crossmolina, Enniscoe	...	...	...
Mor .	Gordon Castle	1·25	32	62	,, .	Mallaranny	6·18	157	...
,,	Grantown-on-Spey	1·14	29	47	,, .	Westport House	4·92	125	106
Na .	Nairn, Delnies	1·63	41	82	,, .	Delphi Lodge	11·07	281	...
Inv ..	Ben Alder Lodge	4·00	102	...	*Sligo*	Markree Obsy.	5·68	144	146
,, .	Kingussie, The Birches	1·86	47	...	*Ferm*	Enniskillen, Portora ..	4·64	118	...
,, .	Fort Augustus	3·25	83	60	*Arm.*	Armagh Obsy.	3·37	86	134
,, .	Loch Quoich, Loan	12·00	305	...	*Down*	Warrenpoint	5·66	144	...
,, .	Glenquoich	10·47	266	76	,, .	Seaforde	6·11	155	194
,, .	Inverness, Culduthel R.	1·48	37	...	,, .	Donaghadee	4·18	106	165
,, .	Arisaig, Faire-na-Squir	4·76	121	...	,, .	Banbridge, Milltown .	3·69	94	165
,, .	Fort William	8·83	224	92	*Antr.*	Belfast, Cavehill Rd. ..	4·76	121	...
,, .	Skye, Dunvegan	5·43	138	...	,, .	Glenarm Castle	6·03	153	...
,, .	Barra, Castlebay	2·33	59	...	,, .	Ballymena, Harryville	4·11	104	111
R&C	Alness, Ardross Cas. ..	2·40	61	63	*Lon* .	Londonderry, Creggan	3·43	87	95
,, .	Ullapool	3·76	96	...	*Tyr* .	Donaghmore	4·66	118	...
,, .	Torridon, Bendamph ..	8·50	216	90	,, .	Omagh, Edenfel	4·77	121	135
,, .	L. Carron, Plockton ...	6·60	168	...	*Don* .	Malin Head	3·18	81	122
,, .	Stornoway	4·56	116	88	,, .	Rathmullen	3·38	86	...
Suth.	Dunrobin Castle	...	...	...	,, .	Dunfanaghy	3·58	91	88
,, .	Lairg	2·27	58	...	,, .	Narin, Kiltoorish	5·48	139	...
,, .	Tongue Manse	2·49	63	63	,, .	Killybegs, Rockmount .	6·35	161	113

Climatological Table for the British Empire, August, 1923

STATIONS	PRESSURE		TEMPERATURE							Relative Humidity	Mean Cloud Am'nt	PRECIPITATION			BRIGHT SUNSHINE	
			Absolute		Mean Values				Mean Wet Bulb			Am'nt	Diff. from Normal	Days	Hours per day	Percentage of possible.
	Mean of Day M.S.L.	Diff. from Normal	Max.	Min.	Max.	Min.	½ max. and min.	Diff. from Normal								
	mb.	mb.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	%	0—10	mm.	mm.			
London, Kew Obsy.	1014·3	— 1·0	85	43	70·9	53·2	62·1	+ 0·5	56·6	70	5·1	40	— 17	8	8·0	55
Gibraltar	1016·0	+ 0·8	95	65	86·0	69·2	77·6	+ 1·7	69·5	68	2·1	1	— 3	1	...	...
Malta	1014·6	+ 0·2	89	71	84·5	74·5	79·5	+ 1·2	73·0	71	1·6	0	— 3	0	...	...
Sierra Leone	1013·8	+ 0·5	86	69	82·8	72·0	77·4	— 0·8	73·0	81	7·6	554	—348	22	...	...
Lagos, Nigeria	1013·1	— 0·5	85	69	81·6	72·1	76·9	— 0·2	73·5	79	8·3	3	— 65	2	...	...
Kaduna, Nigeria	1015·0	+ 1·2	85	66	80·7	68·7	74·7	+ 0·9	68·8	85	1·9	116	—180	16	...	...
Zomba, Nyasaland	1017·8	+ 1·6	84	50	75·0	55·5	65·3	+ 0·6	...	83	4·0	28	+ 20	5	...	...
Salisbury, Rhodesia	1019·0	— 0·1	85	33	76·4	43·3	59·9	0·0	51·2	53	1·5	4	+ 2	1	...	...
Cape Town	1020·3	+ 0·1	88	39	64·2	48·4	56·3	+ 1·1	53·5	80	4·6	81	— 6	11	...	...
Johannesburg	1021·5	+ 1·2	78	31	68·3	46·7	57·5	+ 3·6	43·5	47	0·9	1	— 8	1	10·1	91
Mauritius	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Bloemfontein	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Calcutta, Alipore Obsy.	997·9	— 3·1	96	77	87·1	78·4	82·7	— 0·3	78·7	90	9·2	423	+114	20*	...	...
Bombay	1004·5	— 1·2	87	76	84·2	77·5	80·9	+ 0·2	76·3	85	9·5	221	—139	18*	...	...
Madras	1005·5	0·0	101	75	98·5	79·0	88·7	+ 3·0	74·6	59	6·1	84	— 41	6*	...	...
Colombo, Ceylon	1010·3	+ 1·4	87	70	85·1	76·0	80·5	— 1·0	77·0	74	8·8	208	+123	28	6·1	49
Hong Kong	1002·0	— 3·2	93	74	85·4	77·5	81·5	— 0·6	77·4	84	7·5	871	+506	22	5·1	40
Sandakan	...	...	92	73	88·5	74·3	81·4	— 0·5	† 76·3	†78	...	314	+109	15	...	...
Sydney	1019·2	+ 1·0	80	42	63·3	47·7	55·5	+ 0·5	49·9	67	4·2	104	+ 26	15	6·5	60
Melbourne	1019·0	+ 0·9	69	34	57·8	43·1	50·5	— 0·6	47·4	72	5·5	45	— 1	15	5·4	50
Adelaide	1020·3	+ 1·1	74	39	61·0	45·8	53·4	— 0·5	48·4	67	5·8	57	— 7	15	5·5	51
Perth, W. Australia	1020·3	+ 1·5	77	41	64·2	49·1	56·7	+ 0·7	51·9	72	5·3	99	— 44	17	5·6	51
Coolgardie	1020·7	+ 1·4	79	31	65·2	41·7	53·5	— 0·1	48·1	49	3·5	5	— 21	5	...	...
Brisbane	1019·6	+ 0·6	76	41	68·9	49·0	58·9	— 1·7	54·3	63	3·2	18	— 38	6	8·6	77
Hobart, Tasmania	1014·2	+ 0·6	65	35	56·7	41·7	49·2	+ 1·2	44·5	68	5·5	41	— 6	14	6·0	58
Wellington, N.Z.	1019·1	+ 4·4	61	30	54·0	39·6	46·8	— 1·7	43·0	73	5·0	88	— 28	15	5·8	56
Suva, Fiji	1014·4	+ 0·1	86	63	77·4	68·0	72·7	— 1·0	68·9	80	7·3	160	— 49	20	...	...
Kingston, Jamaica	1014·1	+ 0·4	98	71	92·6	73·9	83·3	+ 1·8	...	65	5·5	20	— 73	7	...	...
Grenada, W.I.	1014·5	+ 1·9	87	72	84·5	74·4	79·5	0·0	75·5	77	4·9	184	— 55	22	...	...
Toronto	1014·2	— 1·2	90	43	76·3	55·2	65·7	— 0·9	58·4	69	3·8	91	+ 21	9	...	...
Winnipeg	1015·1	+ 1·2	91	38	74·8	49·6	62·2	— 0·8	56·2	62	3·1	17	— 43	8	...	...
St. John, N.B.	1013·2	— 2·2	79	42	66·0	49·9	57·9	— 2·7	53·7	82	5·6	103	+ 5	13	...	...
Victoria, B.C.	1016·9	— 0·3	81	49	68·8	53·1	60·9	+ 0·8	56·3	84	3·4	20	+ 3	4	...	...

* For Indian stations a rain day is a day on which 0·1 in. (2·5 mm.) or more rain has fallen. † Mean of observations at 9h., 15h., 21h., from April, 1923.

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Progress in the Study of World Weather

DR. WALKER'S researches into the relations of weather in different parts of the globe are well known. The eighth of the series of memoirs* is devoted to an attempt to find the causal connection between variations of pressure and rainfall in different centres, in order to facilitate the discovery of methods of long range forecasting. All the work is carried out quantitatively by means of correlation co-efficients, and in the course of the paper nearly a thousand such co-efficients are introduced, so that the generalisations have a solid basis of facts.

The first chapter deals with solar relations. When Wolf's sunspot numbers are correlated with various meteorological elements some interesting relationships are found, but in the great majority of cases the co-efficients are small. The negative correlation between sunspots and temperature is found to persist, even when the effect of rainfall on temperature is allowed for. On the other hand the correlations between temperatures and the solar radiation measured at Mount Wilson are generally positive, and it appears that sunspots, although normally associated with increased radiation, also have the effect of increasing the opacity of the atmosphere towards solar radi-

* Correlation in Seasonal Variations of Weather, viii. A preliminary study of World Weather. By G. T. Walker, F.R.S., *Ind. Met. Mem.*, Vol. xxiv., part iv., Calcutta, 1923.

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ation, and hence the maximum temperatures are lowest at spot maxima. It is admitted that further data are required to support this conclusion.

Variations of solar radiation are however found to be quite inadequate for explaining the seasonal abnormalities of the weather, and in the later chapters the explanation is sought in the previous distribution of seasonal features over the earth. For this purpose the quarterly means of pressure (December to February and June to August) are found for each year at fourteen "action centres," and in addition the seasonal rainfall at seven "precipitation centres." Each of these values is correlated with all the others, not only for the same season, but for two quarters before and two quarters after, and in special cases a number of additional co-efficients are calculated. The generalisation which emerges from this mass of detail is that there are two areas, the first including America, the Pacific Ocean and the Azores, and the second the Indian Ocean, Australia, Asia and Iceland: the members of each group have positive correlation of contemporary pressure with the members of the same group, and negative correlation with the members of the other group. "There is a swaying of pressure on a big scale backwards and forwards between the Indian Ocean and the Pacific Ocean, and there are swayings on a much smaller scale between the Azores and Iceland and between the areas of high and low pressure in the North Pacific; further, there is a marked tendency for the 'highs' of the last two swayings to be accentuated when pressure in the Pacific is raised and that in the Indian Ocean lowered."

The two areas are similar to those found by Prof. T. H. Bigelow to have opposed or direct relations to the area of solar prominences. Since direct solar influences have already been ruled out, this similarity must mean that "variations of world weather tend to occur in a definite manner, *i.e.*, to be associated with definite swayings or surges of pressure, and that changes in solar conditions tend to favour or check these weather changes."

What is the immediate cause of this swaying of pressure? Variations of temperature are found to be a result and not a cause; variations in the intensity of the atmospheric circulation may have something to do with it, but the main cause, as regards the southern hemisphere at least, is found in the Antarctic. There appears to be a marked negative correlation in winter between pressure in the Antarctic, near Snow Hill, and in South America, so that when pressure in the Antarctic is low pressure in South America is high. At this stage we must turn aside for a moment to consider the oceanic circulation in the southern hemisphere. This is mainly counter-clockwise round the edges of the basins, *e.g.*, from the neighbourhood of Cape Horn one current travels eastward in the Southern Ocean to South Africa

and Australia, sending a branch, the cold Benguela current, northward along the west coast of Africa, while another, the Humboldt current, travels northward along the coast of Chile, turning westward, as the south Equatorial current, and reaching Samoa and finally eastern Australia. When pressure in South America is high, the temperature near the South Orkneys is high, and the eastward current from the region of the South Orkneys will be less cold than usual and will bring lower pressure along with it. This wave of low pressure will in time reach Cape Town, Mauritius, and south-east Australia, and its progress is followed by means of correlation co-efficients. From South America to Cape Town the wave takes about six months, and it takes about the same interval from South America to Mauritius, so that the two latter appear to be on different parts of the same wave front instead of being connected in series. From Mauritius to Australia the interval is one or two months.

Returning to South America, we find that when pressure is high there, the cold Humboldt current will be strengthened, and a wave of high pressure will travel westwards from South America, reaching Samoa nearly a year later, and south-east Australia in another three months. Thus the opposition between the pressure changes in the Indian and Pacific oceans is mainly due to the propagation of waves of pressure of opposite signs eastward and westward from South America and the regions south of it. The objection that such pressure waves would be rapidly damped out is met by supposing them to be amplified by the changes of pressure associated with monsoon rainfall in India and Australia, and possibly also by further influences from the Antarctic. The connection between the solar prominences and these Antarctic influences we are left to infer. The effect of heavy rainfall from an air current crossing any region on the subsequent rainfall of other regions in the path of the air current, owing to changes in the lapse rate and in the surrounding pressure distribution, is also discussed in some detail. The general result seems to be that the causal connection between weather in successive seasons in different parts of the world present an adequate explanation of most of the seasonal abnormalities. Although the paper is termed a " preliminary study," and the influences dominating Indian monsoon rainfall are specifically left for future discussion, the work is rich in suggestions. For example, it is pointed out how the method of forecasting adopted by Braak,* in Java, could be simplified and improved, and the thorough groundwork laid down will prove invaluable to all interested in long range forecasting.

C.E.P.B.

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* See *Meteorological Magazine*, Vol. 55, 1920, *p.* 205.

Discussions at the Meteorological Office

February 18th, 1924. *On the nature of atmospherics.* By R. A. Watson Watt and E. V. Appleton (Proc. Roy. Soc., Vol. 103, 1924, p. 84). *Opener*—G. I. Taylor, F.R.S.

The paper by Messrs. Watt and Appleton, which formed the text for this discussion, was reviewed in the *Meteorological Magazine* last April. It will be remembered that the first fruits of the use of the cathode ray oscillograph in the study of atmospherics were set out. In the oscillograph or as we should prefer to call it, the oscilloscope, there is a stream of electrons impinging on a fluorescent surface. Movements of the point of impact are produced by changes in the electric forces that act on the stream. By connecting one pair of terminals of the oscilloscope to a circuit in which regular electric vibrations can be produced the luminous spot on the fluorescent surface is drawn out into a line. When another pair of terminals is connected to an aerial the spot is sensitive to electric waves coming from a distance. Such waves give it a movement at right angles to that produced by the local oscillator and instead of a straight line a curve is seen. As was pointed out by Professor Taylor, curves such as are reproduced in the paper are not always easy to interpret: they flash out apparently instantaneously and there is no direct evidence as to which is the beginning and which the end of the incoming wave.

Dr. Appleton and Mr. Herd, who took part in the discussion, were able to report that great progress had been made during the months that had elapsed since the paper was published. The difficulty of interpretation has been got over by an ingenious alteration in the oscillating system which controls the persistent movements of the luminous spot. Instead of moving right and left in simple harmonic motion like a pendulum bob, the spot has been made to move comparatively slowly in one direction and to return a hundred times as fast in the opposite direction. (An analogy may be found in the quick process of pumping up a tyre and the slow process of emptying it through a very small puncture or other slow leak, but in the electric system, pumping takes ·0001 of a second, emptying ·01 of a second) By this device the interpretation of the pictures seen in the oscilloscope has been greatly facilitated as a transient curve is only visible during the comparative slow left to right movement.

Perhaps the most important result is that it has become possible to distinguish between the dynamical and statical effects of the electrical disturbances. If a log were to be dropped into a well-filled bath a water-level recorder would show first the waves, then a semi-permanent change of level and then a gradual return to the original level as the water escaped through

the overflow pipe. In somewhat like manner the oscilloscope permits distinction between the change in electric field due to a comparatively near lightning flash, and the electro-magnetic wave radiated as the result of such a flash occurring at a much greater distance. It is now possible to recognise from the curve seen in the oscilloscope whether a particular atmospheric is due—

(A) To the nett change of field caused by lightning within a few hundred miles, or

(B) To the true radiation propagated from lightning occurring, say, in Equatorial regions, or

(C) To a combination of both cases, a discharge at an intermediate distance.

The apparatus as constructed at present is not safe for use when thunderstorms are near by. It is hoped that before long, it will be possible to investigate the variations of electric potential produced by lightning in the immediate neighbourhood, and so bring this work into line with Mr. C. T R. Wilson's*. The vexed question whether clouds with positive and negative "polarity," *i.e.*, with + charges above and − charges below and *vice versa*, are both possible, will then be settled. Dr. Appleton gave it as his opinion that all atmospherics were due to lightning: the most prolific sources of atmospherics were certainly in the tropical belt and the diurnal variation in the strength and bearing of these electric waves could be explained by the variation in the frequency of thunderstorms throughout the day.

From the meteorological point of view this is perhaps a little disappointing. If atmospherics are merely broadcasted news of the occurrence of thunderstorms it is hardly likely that they will serve as the key to the mysteries of the weather. At the same time, the ability to distinguish between the fields due to local and remote discharges will surely prove of considerable meteorological value.

March 3rd, 1924. *Der tägliche Gang der Temperatur in der freien Atmosphäre über Lindenberg.* By H. Hergesell (Braunschweig, Die Arb. der Preuss. Aero. Obs. bei Lindenberg, XIV Band). *Opener*—Capt. D. Brunt, M.A., B.Sc.

The observations of upper air conditions at Lindenberg, the aerological research station near Berlin, form a unique series, daily kite ascents having been made almost without a break since 1905. To ensure a good distribution of observations and provide information as to diurnal variations, an ingenious time-table was adopted for two years, from May 1917 to June 1919, the hours of the ascents moving on from day to day. Professor

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* *Met. Mag.*, Vol. 55, Dec., 1920, p. 243.

Hergesell has determined the average temperature for each hour of the day in summer and in winter at various heights up to 5,000 metres. To compensate for the comparatively small number of observations, a few hundred at each hour, the readings at successive levels are correlated and the means are adjusted by comparison with the continuous records made at the observatory. Finally the hourly values are smoothed by harmonic analysis. The results are striking. In summer the type of diurnal variation with which we are familiar, the highest temperature in the afternoon, the lowest at sunrise, persists up to about 2,000 metres; above this level there is one maximum only, at noon. It is found that for about 4 hours a day the average lapse-rate in the lowest kilometre is in excess of the adiabatic rate, 10°C. per kilometre. At higher levels it is hottest at noon, coldest at midnight, the range is small, however, only 3°F.

In winter conditions are much more complicated; at the higher levels there are three maxima and three minima in the 24 hours. Much work has been devoted to the search for an explanation of this curious phenomenon. It appears that there is a corresponding oscillation in the upper winds and that the fact that air coming from the south is warmer than wind from the north will account for the observed changes of temperature.

As was pointed out by Captain Brunt, this theory requires the support of more direct observations, such as could be obtained by keeping a kite at the same height for several days. In the discussion doubt was expressed as to whether the material available for the determination of diurnal variations of temperature had been subdivided enough. The results given for summer and winter did not support each other. It would have been more satisfactory if four seasons had been taken so that any progressive change of type could have been traced.

Perhaps the most important result of the whole investigation is that the regular temperature changes in the middle atmosphere are small, insignificant in comparison with the changes from day to day. For establishing this result Dr. Hergesell merits our thanks.

The subjects for discussion for the last two meetings of the session will be:

March 17th, 1924. *An aerological survey of the United States. Part I., Results of observations by means of kites.* By W. R. Gregg (M.W. Rev.: Supplement No. 20, Washington, 1922). *Opener*—L. H. G. Dines, M.A.

March 31st, 1924. *Radiative equilibrium: the insolation of an atmosphere.* By E. A. Milne (Phil. Mag., Vol. 44, 1922, p. 872). *Opener*—M. A. Giblett, M.Sc.

Royal Meteorological Society

THE monthly meeting of the Society was held on Wednesday, February 20th, at 49, Cromwell Road, South Kensington, Mr. C. J. P. Cave, M.A., J.P., President, in the Chair.

Prof. S. Chapman, F.R.S.—The lunar atmospheric tide at Mauritius and Tiflis.

The following is an abstract—The moon is known to produce a tide in the atmosphere which reveals itself by a small semi-diurnal variation of barometric pressure during each lunar day. The range of this pressure oscillation is small, and can only be determined by computation from long series of records. In previous papers the results of such calculations have been given for Greenwich, Aberdeen, Batavia and Hongkong. The investigation has been continued because the phase of the tide is found not to have the value which would be expected (corresponding to high pressure nearly at upper and lower transit of the moon) but to vary with the station and also with the season. The present paper adds two new determinations to those already mentioned. It appears to be too early as yet to form definite conclusions as to the cause of the irregularities of phase which are revealed.

Prof. S. Chapman, F.R.S.—The semi-diurnal oscillation of the Atmosphere.

This paper deals with the cause of the atmospheric oscillation which manifests itself in the semi-diurnal variation of barometric pressure. The magnitude of this variation and its regularity of occurrence over the greater part of the globe, support the view which Kelvin first suggested, and which has received confirmation from the calculations of Margules, Hough and Lamb, that the oscillation is magnified by resonance, its period of twelve solar hours being in near agreement with a period of free oscillation of the atmosphere. It has remained an open question, however, whether the oscillation was mainly caused by the daily heating and cooling of the atmosphere, or whether the sun's gravitational influence also played an appreciable part in the phenomenon. This uncertainty rendered it difficult to explain, even roughly, the observed phase of the oscillation. In the present paper an attempt is made to estimate the relative importance of the two causes, assuming that the semi-diurnal changes of temperature in the lower atmosphere are mainly due to the thermal conduction upwards from the ground. The result is somewhat indefinite, not because of mathematical difficulties, but chiefly owing to the scarcity of reliable data concerning the semi-diurnal variation of temperature, and the eddy conductivity, over large parts of the earth. It seems not unlikely, however, that the sun's thermal and gravitational

influences are about equally responsible for the oscillation, and on this hypothesis the observed phase of the oscillation can be accounted for fairly well. The magnitude of the oscillation indicates that the approximation of the adjacent free period to twelve solar hours must be very close, that is, to within a few minutes: this is much nearer than existing theories of atmospheric vibrations can account for.

C. S. Durst, B.A.—The relationship between current and wind.

A large number of observations made by ships at sea are examined in the light of Ekman's theory of ocean currents. It is found that the theory is borne out by the average direction of flow, and that the average velocity of current is directly proportional to the speed of the wind. From Jeffreys's work on the theory of turbulence as applied to the ocean, coefficients of turbulence are deduced for various regions of the seas.

Correspondence

To the Editor, *The Meteorological Magazine*

Weather and Magnetic Character

THE reference, on p. 10 of the *Meteorological Magazine*, February, 1924, to the concluding remarks in my recent address to the Royal Meteorological Society does not seem to present my argument altogether correctly. The argument used was as follows:—

The terrestrial element that shows most unmistakably the sunspot (11-year) period is Terrestrial Magnetism. It is the range of the regular diurnal variation, which is much enhanced at sunspot maximum, which shows the sunspot relation most clearly. Now this enhancement of the regular diurnal variation is also exhibited during magnetic disturbance, and is then very large indeed in high magnetic latitudes. The cause of the enhancement in either case is believed to be increased ionisation of the atmosphere due to radiation of some kind from the sun. It is thus reasonable to regard magnetic disturbance as associated with the presence of some at least of the atmospheric conditions normal to sunspot maximum. This suggests that even on the side of meteorology days of high magnetic disturbance may differ from magnetically quiet days in the same way as days near sunspot maximum differ from days near sunspot minimum. A comparison of meteorological phenomena on magnetically disturbed and quiet days might thus prove a useful auxiliary in the investigation of the relation, if any, between meteorology and sunspot frequency.

C. CHREE.

Kew Observatory, February 21st, 1924.

A Cloud Pendant

ON March 31st, 1923, I, my wife and daughter saw from here what we thought was a " Waterspout," about two to three miles south-west. It was prolonged as an elephant's trunk and " felt about " in the same way as the animal's trunk does. I should estimate that the diameter was from 50 to 100 yards and that the trunk came within, say, 200 feet of the ground.

The spout gradually came down from a dark horizontal narrow streak in the larger cloud. We could see a revolving inside the trunk which seemed to be sucking air, leaves and dust upwards It was apparently not emitting water. The trunk gradually drew up into the darker horizontal streak and the whole heavy cloud passed north-westwards. There was only ·04 inch of rain here with thunder.

Would this be a cyclone in miniature ? I heard of no damage done or anyone else who saw it. The shape of the pendant was like that shown in Fig. A of the plate facing page 281 of the *Meteorological Magazine* for January, 1921. The volute of Fig. B did not occur.

A. E. CHRISTY.

Wellmead, Fryerning, Ingatestone, Essex, January 6th, 1924.

A Northerly Weather Type

The weather changes described by Mr. Edwards in the following letter occurred during a day when an unstable current of air which had come from the neighbourhood of Iceland covered most of the United Kingdom. Heavy showers were reported at many places.

A brisk fall in the barometer set in about midnight on the 23rd, the wind increased quickly from WNW to force 6 about 5h. on the 24th with intermittent rain and cumuliform stratus moving from WNW at about 2,000 feet. At 9h. 30m. the low cloud sheet commenced to break and large cumulus clouds were revealed at about 5,000 feet, moving from NW'N. The forenoon continued mainly cloudy or overcast with a slight decrease in the force of the wind to force 5 and occasional showers of slight rain. Observations of upper cloud motion showed a veer to NNW at about 20,000 feet. Much false cirrus could be seen to the northwards about noon but no true cumulo-nimbus was detected. Low cloud increased again after 13h., being somewhat ragged and irregular in shape. Temperature reached its diurnal maximum (44°F.) at 14h. 40m.

The sky to the north-east became decidedly gloomy about 14h. 30m. and this appearance persisted. To north-westwards the low clouds were patchy and revealed yellowish masses of false cirrus at a decidedly lower elevation than usual. The surface wind was north-westerly at 15h. force 5, and the low

cloud motion was unchanged. The gloom to the north-east increased at 15h. 10m. a film of smoky nimbus at about 1,000 feet spread rapidly in from north-east. Surface wind shifted quickly through N to NE without any great change in velocity. Rain commenced immediately before the wind shift, after which it turned to small sleet and soft hail, being rather violent. The fall continued for about 15 minutes, being very mixed in character, some large wet flakes of snow being observed towards its close. An aneroid barometer showed a rise immediately after the wind shift and temperature fell 3°F.

At 16h. 15m. the sky was almost clear, and the wind had backed to WNW and fallen to force 2. To the west and south west extending to about 20° above the horizon were some highly picturesque masses of cumulo-nimbus with very contorted false cirrus at their summits. They were moving rather quickly south.

At 17h. there was evidence of a subsidiary squall. The surface wind fell to almost calm—it was south for a few moments and then at 17h. 10m. there was a sudden gust (force 4) from N. This settled down into a steady breeze which lasted for the rest of the evening. Fracto cumulus appeared to be associated with this squall and a few moderate sized patches formed very quickly. Their motion was from NNE, and their elevation was estimated at 3,000 feet.

FRANK EDWARDS.

177, Clarenden Road, Whalley Range, Manchester, February 26th, 1924.

Wind and Weather

IN the *Meteorological Magazine* for January, 1924, page 285, there is a short review of the little book on "Wind and Weather."

In speaking of Skiron—the north-west wind—the types have made what was written "his husky Highness" into "his dusky Highness." Unintentionally they have changed the complexion of the north-west wind. There are different meanings for the word "husky"; but a common usage in America is strong, robust, vigorous; and it was used in this sense to characterize Skiron.

We did say that, as the lord of hot air, "his husky Highness might not inappropriately adorn legislative halls and editorial sanctums"; but we should have been more explicit; for this may not hold for *all* editorial sanctums.

ALEXANDER MCADIE.

Blue Hill Observatory, Readville, Mass., U.S.A., February 4th, 1924.

[We tender apologies to Prof. McAdie for the misquotation. His note has led us to consult the dictionaries. In the New English Dictionary there is a quotation from Lisle's Husbandry of the year 1722. "We had also for the most part very dry

husky winds." The usage mentioned by Prof. McAdie is to be found in Webster's Dictionary with the qualification " Colloq. U.S.," and also in Farmer and Henley's Dictionary of Slang and Colloquial English (1905), where it is described as an adjective meaning stout, well built. There is no mention of it in the Dictionary of Americanisms by J. S. Farmer, which was published in 1889, but Thornton's American Glossary, 1912, defines it as rough and sturdy, and quotes from the New York Evening Post, 1910, " as husky as a buffalo."—ED. *M.M.*]

NOTES AND QUERIES

Simultaneous Rain and Fog

FOG and drizzle are frequently associated, but in London it is rare for appreciable rain to be simultaneous with dense fog. On Sunday, December 30th, 1923, rain commenced at Chiswick, in the West of London, about 11h. After half an hour, fog came on suddenly ; at the worst, the range of visibility of objects such as trees was about 60 yards : the improvement was gradual, but it was still raining when the fog had gone. The rate of rainfall at South Kensington was about 1·5 mm. per hour ; as the fall was very steady the rate at Chiswick must have been nearly the same.

Cloud and Fog in the Desert

OBSERVATIONS made at the auxiliary stations associated with the Observatory at Arequipa, in Peru, during the years 1896 to 1900, have been published as Vol. 86, Part 3, of the Annals of the Astronomical Observatory of Harvard College. For one of the stations, La Joya, near the centre of the Desert of Islay, the total rainfall for the five years is given as 0.21 inch, the wettest month having 0·04 inch. Nevertheless the sky during the summer months is often cloudy ; in the average January the evening observations include clear sky on six occasions, fair on seven, and cloudy on eighteen. A few observations were also made at Cachendo, on the southern edge of the desert, to see if better conditions for astronomical work could be found there. Cachendo is at 3,250 ft., and about 10 miles from the Pacific. This station was found to be subject to fog ; on one occasion the observer reported " From the hill south of the hotel, I watched the fog come up from the sea. It appeared just before sunset, filling at first the lower valleys and ravines and then rushing past me like a race horse, so that in less than 10 minutes the entire pampa as far as I could see was filled with it."

Pilot Balloon Observations at Barcelona

RAPID progress has been made recently in the publication of the pilot balloon ascents made at Barcelona.* Two details catch the eye. The routine of the observations is so arranged that the balloon ascends at 2 metres a second and readings are made at intervals of 50 or 100 seconds. As the wind speed is to be found in metres per second, the simplification in the arithmetic as compared with that in the English method of observing at every minute is appreciable. In the tabulation of the results the mean wind for each interval of 200 metres is set down, not the wind *at* particular levels. Bigger steps, 250 or 300 metres, are shown in the later tables.

In the individual ascents, large variations of wind direction in the lowest kilometre are found as a general rule. The longest set of observations in the collection was made on November 21st, 1922, when the balloon was kept under observation for about 3 hours. As is pointed out in a prefatory note, the assumption of a uniform rate of ascent is misleading in such a case.

There are two records of dead calms reaching to considerable heights. On June 25th, 1923, at 7h. 15m. the calm extended to 900 metres; on June 28th, at the same hour, to 600 metres. On the former occasion the upper wind was from the north, on the latter occasion it was from west; the average strength of the current between 600 metres and 900 metres was 10 miles an hour. Perhaps some reader can give details of other noteworthy calms.

The Dry Winter of 1922-23 in Spain

IN the same series of publications† a note by Gabriel Campo on the characteristics of last winter has been issued. The note contains some interesting and novel composite charts on each of which the position of the 1014 mb. isobar is shown for every day of a month. On the chart for January, 1923, there is a tangle of lines over north-west Europe and another round the Gulf of Lions, but only two lines enter Spain, which was persistently within the ambit of the Azores anti-cyclone. The November chart has a conspicuous tangle about the Straits of Gibraltar to mark the occurrence of low pressure in that region. The rainfall of the four months, November, 1922, to February, 1923, at Barcelona was 51 mm. as compared with 370 mm. in the same months of the previous winter.

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* SERVEI METEOROLÒGIC DE CATALUNYA: NOTES D'ESTUDI. Nos. 19, 22, 25 and 28. Barcelona, 1923.

† SERVEI METEOROLÒGIC DE CATALUNYA: NOTES D'ESIUDI. No. 21. Barcelona, 1923.

The Observatories on Mont Blanc

IN an article printed in the *Times* of March 4th, Dr. A. E. H. Tutton gives an account of the observatories erected on Mont Blanc. There have been four. The first, which was constructed on the Col des Bosses by M. Vallot in 1890, was eventually buried to the roof in snow, and was abandoned in 1898, when M. Vallot erected his present observatory on the Rocher des Bosses 14,312 ft. above sea level. After 25 years this observatory still defies the tempests and the snows. The veteran scientist has made 35 expeditions to the summit and to his observatory, and still takes the liveliest interest in the scientific memoirs, now over a hundred in number, which record the results of the observations.

In the year 1890 Dr. Janssen visited the first observatory, and in spite of warnings from M. Vallot, who pointed out that one cannot establish anything on a snowfield, persisted in erecting an observatory on the unfathomable* snow of the summit itself. This observatory was constructed in 1893; by 1908 it had disappeared under the snow. A considerable portion of the woodwork was dug out and it is now being used up as fuel at the Vallot observatory. The loss of the summit observatory was much regretted, and M. Vallot acceded to a request to erect a very light one to replace it, but with the warning that the place would not form a safe shelter in thunderstorms. The warning was tragically verified in 1910, for a party engaged in observing was surprised by a thunderstorm and one of the party was killed by lightning. The following summer this structure was partly buried and " the pure white dome of snow is now unsullied and free."

Weather and History

THE many who work at routine meteorology, observing, computing and so on, and who feel, perhaps, that the scientific value of the work is not sufficient recompense, may be stimulated by the views of a modern historian. At the meeting of the Society of Bookmen on November 6th, Mr. Philip Guedalla, speaking of the writing of history, laid great stress on the necessity for making it readable. Weather, he said, was a necessary and neglected detail. It was necessary not only as a causative factor but also as a part of the picture. " If you want to make a man see and feel an incident tell him what the weather was like." He continued that the research involved must be accurately carried out, as there is a distinct danger of over-statement. It is difficult not to choose the most effective weather as a background. He

* Unfathomable is Dr. Tutton's word. It tempts us to ask whether the snow *has* been fathomed.

cited an instance in his own experience, when, wishing to find that a certain night in Paris was foggy, he searched the records vainly for even a mist!

This appreciation of meteorology by the historian is encouraging in two ways. It suggests much useful and very pleasant work to be done in old records on the lines of, say, Lowe's *Chronology* or "*Weather in War-Time*," by Richard Bentley, F.S.A.,* and it puts modern work in a new perspective. To regard year books, lustrum sheets, pocket registers and suchlike as some material for history and letters is a pleasing viewpoint for those who cannot reach the heights where new theories and other rare plants flourish. D.F.

The Green Auroral Line in the Laboratory

ACCORDING to newspaper reports Professor Vegard, working in the Laboratory of Professor Onnes, at Leyden, has succeeded in obtaining the green auroral line. Nitrogen was cooled until solid particles were produced, and these were submitted to electrical radiation (presumably to bombardment by cathode rays). The light emitted was no doubt examined in the spectroscope, and showed the green line hitherto seen only in aurora. The confirmation of Vegard's hypothesis that nitrogen existing in a solid form in the upper atmosphere would account for the characteristic structure of aurora is very gratifying.

In view of the misleading phraseology of some popular accounts of these experiments it should be emphasized that the hypothesis is that the nitrogen is in the form of minute molecular aggregates, microscopic or ultra-microscopic crystals, and that the atmosphere from 100 kilometres above the earth to the upper limit of the aurora, say, 500 kilometres, consists in the main of such particles. Journalists have referred to the nitrogen as solidified by contact with the cold of outer space, and suggested that the temperature is the absolute zero. Actually, the temperature at which nitrogen freezes is about 63°A. The hypothetical particles are at night receiving radiation from below; the heat rays from the earth itself cannot get through to them; most of the radiation they receive must proceed from the stratosphere: thus, the persistence of the particles would seem to indicate that the heat they radiate in all directions at such a temperature as 63° balances the heat they receive (on one side) from a source at about 220°. The possibility of thermal equilibrium being attained in such a way will no doubt be investigated experimentally.

It is of interest to remember that the Aitken nuclei on which vapour condenses to form clouds are thought to be molecular aggregates or ultra-microscopic crystals, the principal constituent

* *Q.J.R. Met. Soc.*: Vol. xxxiii., April 1907, p. 81.

of which is sea-salt. Vegard's nitrogen particles would seem to be of the same order of magnitude. There is, however, a great difference between the two cases. The Aitken nuclei are supported by the viscosity and turbulence of the air. Vegard's particles are supposed to be kept up by electric forces, and physicists find this part of the theory most difficult to accept.

Soaring Flight

SOME account of the discussion of Dr. Hankin's observations of the soaring flight of birds, dragonflies and flying fish has been given in previous numbers of the *Meteorological Magazine*.* On November 9th Dr. Hankin gave an address on the same subject before the Institution of Aeronautical Engineers in which he dealt with some of the phenomena which accompany soaring flight, the musical whirring sound made by vultures and cheels while soaring, the distortion and change of colour of the wings of soaring birds, etc. But the main subject of the address was the occurrence of steep upward glides without apparent loss of speed. These he had observed frequently but found very difficult to explain as they appeared to occur only on occasions when there were grounds for suspecting that the bird was in a descending current.

In one of his earlier papers† Dr. Hankin stated that soaring flight was due neither to undiscovered wing movements nor to the use of ascending currents. Now, however, he had arrived at the conclusion that soaring flight in descending currents is due to the mixing of ascending and descending masses of air or at least to some kind of turbulent motion. Observations by Mr. J. D. North and experiments by Dr. Betz of Göttingen had helped him to reach this conclusion. Mr. North had observed, from the stern of a steamer, pieces of paper that he had thrown overboard rising continuously when enveloped in dilute descending smoke. That is to say, there was an admixture of ascending air that carried the paper with descending air that carried the smoke particles. According to Dr. Betz such opposed movements can do more for the soaring bird than could the ascending component only. It is in these opposed currents that the bird shoots upwards almost as if fired out of a gun, its course making an angle of between 30° and 80° with the horizon in the case of gulls.

A further point that Dr. Hankin makes is that " the presence of wind seems necessary to permit the development of a soarable area at the stern of a steamer. In the absence of wind there is still a relative wind caused by the movement ahead of the steamer

* Vol. 56, p. 43, Vol. 57, p. 19, and Vol. 58, p. 62.
† *Cambridge, Proc. Phil. Soc.*, Vol. xx., Part iv., p. 460.

and presumably a descending current at the stern. But under such conditions no soarable area is formed. Gulls following the steamer do so by flapping flight." Moreover some winds, though fitted by their force and direction to aid mixing of ascending and descending air masses in the descending current at the stern, do not permit the appearance of a soarable area. It is noteworthy that Dr. Hankin does not appear to have considered the relation of "soarability" to temperature. The growth of the effective eddies will probably depend on whether the air is being cooled or heated by the water it is passing over.

Temperature in Mexico

A VERY full discussion of the temperature of Mexico, by Jesus Hernandez, B.C.E., has been published* by the Weather Bureau of the United States. The observations utilised were made at 70 meteorological stations, and the averages refer to the period from 1901 to 1910. [Perhaps the shortness of this period may be accounted for by political circumstances. Whitaker tells us that President Diaz ruled (except during 1880-4) from 1876 to May 25th, 1911, and that since the fall of Diaz internal disturbances in which eleven Presidents have figured have continued with varying degrees of intensity.]

There are no less than 75 excellent maps. Amongst the most striking are those showing the month to month differences in mean temperature. For example, comparison between May and June shows that on the northern border the latter month is the warmer by 4°C.; on the southern shores of the Gulf of Mexico the two months have the same temperature and on the other side of the isthmus June is colder than May by 1·5°C. Credit must be given to Mr. W. W. Reed of the Weather Bureau for the smooth English of the translation. The report, which is published at the modest price of 10 cents, should be studied by all who are interested in the climate of North America.

The Effect of a Protecting Wire Cage upon Readings of a Grass Minimum Thermometer.

THE observers at several stations have found it necessary to place a wire cage over the grass minimum thermometer in order to protect it against stray tennis balls, thrown stones or prowling animals. It having been suspected that the use of such a cage affected the thermometer readings, an investigation was started at Kew Observatory.

* *Monthly Weather Review.* Supplement No. 23, 1923.

The method adopted was as follows: Three grass minimum thermometers were similarly exposed on the lawn. One was left unprotected. The second was protected by a wire cage 20 inches long, 10 inches wide and 7 inches deep, of which the diameter of the meshes was about 1 inch; the diameter of the wire used was 0·1 inch. This cage rested directly upon the grass. The third thermometer was protected by an exactly similar cage, which, however, was to some extent thermally insulated from the ground by standing upon four wooden feet projecting about an inch above the ground. The three thermometers were read and set daily from January 25th to April 30th, 1923, and, in order to eliminate any individual peculiarities of the thermometers, they were regularly interchanged so that an approximately equal number of observations were obtained from each thermometer in each of the three positions.

If the letter A be used to designate the readings of the thermometer under a cage without insulation, B the readings of the thermometer under a cage with insulation, and C the readings of the thermometer without a cage, then the means of the readings obtained in the different positions are as follows:—

	Average Readings.			Differences	
	A	B	C	A—C	B—C
All nights (94)	35·2	35·0	34·2	1·0	0·8
Nights of Frost (29) ...	28·5	28·1	26·7	1·8	1·4
Nights without Frost (65)	38·2	38·1	37·5	0·7	0·6
Nights of Clear Sky (20) ...	30·8	30·7	29·2	1·6	1·5
Overcast Nights (43) ...	39 3	39·2	38·5	0·8	0·7
Nights of Fog (20) ...	32·1	32·0	31·0	1·1	1·0
Nights of Rain (47) ...	37·6	37·3	36·7	0·9	0·6

When arranged in a series according to increasing readings of the exposed thermometers, the differences A—C and B—C generally diminish from averages of over 2°F. at low temperatures to about 0·2° F. at temperatures from 45° F. to 50° F.

The results suggest that on nights of strong outward radiation (or rather of weak inward radiation) the screening effect of the wire cage is considerable. On the other hand a comparison between these readings and the corresponding readings (S) of the minimum temperature in the screen shows that there is no well marked connection between variations of the ratio $\frac{A—C}{S—C}$ or $\frac{B—C}{S—C}$ and variations of S—C itself.

The matter is being further investigated; meanwhile it is clear that the effect of a cage of the kind described increases the reading of the grass minimum thermometer on the average by about 1° F., and on nights of frost by 2° F. or more. Such cages should, therefore, not be used if they can reasonably be avoided.

Review

The Fernley Observatory, Southport. Report and Results of Observations for the year 1922. By Joseph Baxendell.

Mr. Joseph Baxendell's report for the year 1922, has been issued recently. As usual the report contains much useful information such as is not published for any other part of the United Kingdom. An appendix is devoted to the hourly averages of the duration, amount and intensity of rainfall at Southport. It is found that the diurnal variation is well marked, much more so than in London or at Bidston Observatory. At Southport in the hour from 6h. 30m. to 7h. 30m. it rains on the average for 5·5 minutes but in the hour from 12h. 30m. to 13h. 30m. the average duration is only 3·8 minutes; these are the extremes for the day.

Mr. Baxendell's work on periodicity continues. We quote from his report on the 3·1 year period in British weather:—

> "The computations needed for the investigation of meteorological periodicities of the order of a few years, occupied a good deal of Mr. Charles Baxendell's time during the year. Especial attention was devoted to the cycle of nearly 3·1 years, which had been regarded even by its principal discoverer, Dr. H. R. Mill, as being either a temporary, or else a rather complicated and elusive one. We find, on the contrary, that it is one of the most permanent air pressure and rainfall periodicities in this country: in the south of England it is also one of the most intense and important—in some counties, indeed, it probably has no equal. Its exact length appears to be 3·09 years, that value having been determined alike from over 90 years' observations of rainfall at Bolton, and nearly 1½ centuries of air pressure records in London. Moreover, dividing each of those series of data into two equal halves, the amplitudes of the mean sine waves of the earlier and the later halves, are, in each case, nearly identical. The Southport half-century's rainfall data give practically the same phase-angle as the Bolton 90 years' figures (reckoned, of course, from a common starting point); and it is very interesting to find that the phases of both nearly coincide with those of the London, long, air pressure record, *inverted*. The rainfall maxima apparently *slightly* precede the air pressure minima—a very natural circumstance. At Southport, the full range or double amplitude of this periodicity amounts to 14 per cent. of the average rainfall. In southern England the term probably accounts for far more than this. When noticed by Dr. Mill and others, the variation was, however, being for some time greatly re-inforced by 'interference'; an opposite effect is in progress now."

News in Brief

Dr. W. G. Duffield, Professor of Physics at Reading University, has been appointed Director of the new Solarphysics Observatory which is being built on Mount Stromblo, 10 miles from the centre of Canberra, the new capital of Australia.

On February 19th, 1924, there was slight precipitation at 17h. in the form of ice crystals. These crystals, which could be examined as they rested on the sleeve of a coat, were between one and two millimetres in diameter and of various forms, such as have been illustrated in Bentley's microphotographs; the simple patterns, the hub and six spokes, predominated. It must be somewhat rare for a London observer to have the opportunity to enter the symbol ← in his register.

On February 10th the Central Physical Observatory Leningrad (Petrograd) issued a chart covering practically the whole of Europe, and indicating the probable " barometric state " during the second part of the winter of 1923-4 (February to beginning of April). On it are shown the regions likely to be visited by the centres of cyclones and of anti-cyclones. The probable tracks of " coldwaves " are shown by arrows; " premature heat " and storm areas are also marked. It will be interesting to watch the fate of this ambitious forecast.

It is announced that the Deutsche Seewarte is to follow the English example and give up the monthly issue of charts of the North Atlantic. The latest information is to be incorporated in " Pilots," and an endeavour is to be made to issue these monthly.

The following note is gleaned from a review* of " Watch Dogs," a new book by Col. E. H. Richardson, the well known trainer. For blood-hounds, " the best scenting day is one on which evaporation is taking place slowly. A nice moist atmosphere with no wind and a fairly damp soil contribute to conditions whereby successful tracking can take place; when there is high wind or hot sun the trail very quickly becomes obliterated; and when the ground is very hard and dry it does not lie well."

It is interesting to note that these conditions agree generally with those given by W. H. Pick† for foxhounds. Capt. Pick found that the scent was best of all on frosty mornings.

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* Published in the *Illustrated London News*, February 16th, 1924, p. 266.
† *Meteorological Magazine*, Vol. 57, 1922, p. 16.

Two new cases for the display of autographic records at the door of the Meteorological Office were brought into use on February 25th. The exhibits include, besides the autographic records of temperature, humidity, atmospheric pollution, etc., taken at South Kensington during the preceding day, climatological diagrams shewing the conditions during the previous and current week.

The Weather of February, 1924

WESTERLY winds and mild weather prevailed over the British Isles during the first week of February as an anti-cyclone lay off our south-west coasts, and depressions passed eastwards across Iceland to Scandinavia. The first three days of the month were fair, over 8 hours of sunshine being recorded at many places, but after this the weather became dull. A large depression which reached the British Isles from the Atlantic caused high southerly winds and gales on the west coasts on the 8th; there was heavy rain locally in Ireland—57 mm. being recorded at Valencia, and 50 mm. at Dunmanway (Cork). From the 10th to the 14th part of the Atlantic low pressure area moved slowly across the Bay of Biscay and France while pressure remained high over northern Europe; cold easterly winds prevailed over the British Isles bringing a decided fall of temperature. The winds increased to gale force locally on the 12th, 13th and 14th. From the 15th onwards high pressure was maintained westward of Ireland with cold winds varying between west and north. Periodically depressions moved southwards over Scandinavia and the North Sea causing snow and sleet over most of the United Kingdom, but bringing also at first a temporary slight rise in temperature, *e.g.*, temperature rose to 54°F. at Inchkeith on the 21st, and to 46°F. at Kew on the 24th and 29th. The depression on the 29th was very deep and high winds or gales were experienced in all parts of the kingdom. From the 11th onwards the weekly averages of temperature and sunshine were, with few exceptions, below the normal. On the 13th the maximum reading at Balmoral was only 30°F., and on several other days there were places at which the temperature did not rise above 31°F. or 32°F. At Rhayader on the 15th the minimum readings were as low as 15°F. in the screen and 8°F. on the ground. Rainfall was generally below the normal, it was unusually slight in the southern Midlands; 0.5 mm. was the total precipitation for the month at Llanthony Lock (Gloucester), and 2 mm. at Bishop's Canning (Wilts).

In Europe the weather of February was marked by severe snowstorms, gales and avalanches. A hurricane of unusual violence swept across Vienna on the 3rd, causing considerable

damage to property and injury to people, and on the 5th a violent storm broke over Gibraltar early in the morning, when hail swept over the summit of the Rock making it look as if it were snow clad, a sight said to be unknown during the last half century. Snow fell to a depth of 3 ft. in parts of Umbria, and cases of death from cold were reported in Florence. Towards the middle of the month many disasters were caused by great avalanches in Austria. In the latter part of the month heavy snowstorms occurred in Berlin, and snow interrupted railway communication between Madrid and the north of Spain. In northern Europe the international ferry route between Denmark and Sweden was blocked with icefloes on the 2nd, and after the middle of the month traffic between Finland, Sweden and Denmark was impeded in all parts of the Baltic owing to the increase of ice. Some ports were closed to navigation, and at others, *e.g.*, Hangö, Abö, traffic was only carried on by means of ice breakers.

Many lives were lost and much damage to property resulted from a blizzard which visited the Middle West of the United States on the 5th and 6th. Chicago and Davenport were completely cut off from communication with the north and east. Near the beginning of the month an ice bridge formed with startling suddenness across the entire width of the St. Lawrence from Sillery Point, near Quebec, to Levis. The bridge was too insecure for regular traffic and broke after a day or two. It is said that such a bridge has not been formed for 25 years.

Reports from Australia show that further good rains have fallen over Victoria, and fairly general light rains in New South Wales and Queensland.

The special message from Brazil states that plentiful rains occurred in all parts, the monthly average being 39·5 mm., 76·7 mm. and 38·7 mm. above normal in the northern, central and southern districts respectively. Floods occurred in many places, chiefly in the central districts, and these had disastrous consequences in the State of Rio de Janeiro. Temperature continued above normal, 1°C. on the average in the north and centre. Owing to the floods and adverse weather the prospects of the coffee and cane crops are not good. The cotton crop in the north is, however, in fair condition. At Rio de Janeiro pressure was normal and temperature one degree below normal.

Rainfall February, 1924: General Distribution

England and Wales	43	per cent. of the average 1881-1915.
Scotland	60	
Ireland	56	
British Isles	50	

Rainfall: February, 1924: England and Wales.

CO.	STATION.	In.	mm.	Per-cent. of Av	CO.	STATION.	In.	mm.	Per-cent. of Av.
Lond.	Camden Square.....	·65	17	39	*War.*	Birminghm, Edgbaston	·59	15	35
Sur .	Reigate, Hartswood...	·67	17	33	*Leics*	Leicester Town Hall...	·61	15	...
Kent.	Tenterden, View Tower	·87	22	40	,, .	Belvoir Castle.....	·86	22	52
,, .	Folkestone, Boro. San.	·58	15	...	*Rut .*	Ridlington.....	·74	19	...
,, .	Broadstairs	1·10	28	74	*Linc.*	Boston, Skirbeck	1·05	27	72
,, .	Sevenoaks, Speldhurst.	·87	22	...	,, .	Lincoln, Sessions House	·77	20	53
Sus .	Patching Farm.....	·41	10	19	,, .	Skegness, Estate Office.	·80	20	52
,, .	Eastbourne, Wilm. Sq.	·67	17	30	,, .	Louth, Westgate	1·04	26	54
,, .	Tottingworth Park....	1·18	30	50	,, .	Brigg	1·09	28	63
Hants	Totland Bay, Aston...	·28	7	14	*Notts.*	Worksop, Hodsock....	1·25	32	81
,, .	Fordingbridge, Oaklnds	·36	9	14	*Derby*	Mickleover, Clyde Ho..	·56	14	34
,, .	Portsmouth, Vic. Park.	·41	11	20	,, .	Buxton, Devon. Hos...	1·63	41	43
,, .	Ovington Rectory	·42	11	16	*Ches.*	Runcorn, Weston Pt...	·84	21	45
,, .	Grayshott	·77	20	30	,, ..	Nantwich, Dorfold Hall	1·11	28	...
Berks	Wellington College...	·51	13	27	*Lancs*	Bolton, Queen's Park .	1·65	42	...
,, .	Newbury, Greenham..	·55	14	25	,, ..	Stonyhurst College....	1·38	35	41
Herts.	Bennington House....	·83	21	52	,, ..	Southport, Hesketh...	·76	19	36
Bucks	High Wycombe	·68	17	37	,, ..	Lancaster, Strathspey.	·62	16	...
Oxf..	Oxford, Mag. College..	·24	6	15	*Yorks*	Sedbergh, Akay	1·25	32	28
Nor .	Pitsford, Sedgebrook..	·51	13	31	,, .	Wath-upon-Dearne ...	1·15	29	70
,, .	Eye, Northolm.....	·65	17	...	,, .	Bradford, Lister Pk...	·89	23	38
Beds.	Woburn, Crawley Mill.	·48	12	33	,, .	Oughtershaw Hall	2·10	53	...
Cam.	Cambridge, Bot. Gdns.	·73	19	57	,, .	Wetherby, Ribston H..	...	...	...
Essex	Chelmsford, CountyLab	·65	17	...	,, .	Hull, Pearson Park ...	·95	24	57
,, .	Lexden, Hill House...	·63	16	...	,, .	Holme-on-Spalding ...	1·12	28	...
Suff .	Hawkedon Rectory ...	1·19	30	78	,, .	Lowthorpe, The Elms.	1·71	43	94
,, .	Haughley House.....	1·22	31	...	,, .	West Witton, Ivy Ho..	·75	19	...
Norf.	Beccles, Geldeston....	1·79	46	131	,, .	Pickering, Hungate ...	2·03	52	...
,, .	Norwich, Eaton	1·94	49	118	,, .	Middlesbrough	1·27	32	98
,, .	Blakeney	1·05	27	71	,, .	Baldersdale, Hury Res.	1·19	30	39
,, .	Swaffham	1·24	31	79	*Durh.*	Ushaw College	·86	22	54
Wilts.	Devizes, Highclere....	·19	5	10	*Nor .*	Newcastle, Town Moor.	1·08	27	68
Dor .	Evershot, Melbury Ho.	·74	19	24	,, .	Bellingham Manor....	1·05	27	...
,, .	Weymouth, Westham..	1·15	29	53	,, .	Lilburn Tower Gdns...	·89	23	...
,, .	Shaftesbury, Abbey Ho.	·58	15	25	*Cumb*	Penrith, Newton Rigg..	...	...	...
Devon	Plymouth, The Hoe...	1·98	50	68	,, .	Carlisle, Scaleby Hall .	·76	19	34
,, .	Polapit Tamar	1·90	48	59	,, .	Seathwaite	2·20	56	19
,, .	Ashburton, Druid Ho..	2·71	69	57	*Glam.*	Cardiff, Ely P. Stn....	·71	18	24
,, .	Cullompton	·72	18	26	,, .	Treherbert, Tynywaun	·83	21	...
,, .	Sidmouth, Sidmount ..	1·12	28	45	*Carm*	Carmarthen Friary....	·58	15	22
,, .	Filleigh, Castle Hill ...	·85	22	...	,, .	Llanwrda, Dolaucothy.	1·35	34	31
,, .	Hartland Abbey.....	·91	23	...	*Pemb*	Haverfordwest, Portf'd	...	...	...
Corn.	Redruth, Trewirgie ...	2·63	67	70	*Card.*	Gogerddan.....	·99	25	31
,, .	Penzance, Morrab Gdn.	1·57	40	47	,, .	Cardigan, County Sch. .	·91	23	...
,, .	St. Austell, Trevarna..	2·33	59	61	*Brec .*	Crickhowell, Talymaes	1·50	38	...
Soms	Chewton Mendip	·60	15	18	*Rad .*	Birm.W.W.Tyrmynydd	1·74	44	33
,, .	Street, Hind Hayes ...	·35	9	...	*Mont.*	Lake Vyrnwy	·83	21	18
Glos..	Clifton College	·44	11	19	*Denb.*	Llangynhafal	·76	19	...
,, .	Cirencester	·71	18	31	*Mer .*	Dolgelly, Bryntirion..	2·26	57	51
Here .	Ross, County Obsy.	·28	7	14	*Carn.*	Llandudno	·48	12	23
,, .	Ledbury, Underdown.	·42	11	23	,, .	Snowdon, L. Llydaw 9	3·50	89	...
Salop	Church Stretton.....	·44	11	20	*Ang .*	Holyhead, Salt Island.	·60	15	25
,, .	Shifnal, Hatton Grange	·69	17	43	,, .	Lligwy	·65	17	...
Staff.	Tean, The Heath Ho...	·92	23	46	*Isle of Man*				
Worc.	Ombersley, Holt Lock.	·43	11	26		Douglas, Boro' Cem...	1·03	26	32
,, .	Blockley, Upton Wold.	·87	22	38	*Guernsey*				
War	Farnborough.....	·50	13	24		St. Peter Port, Grange .	...	...	...

Rainfall: February, 1924: Scotland and Ireland

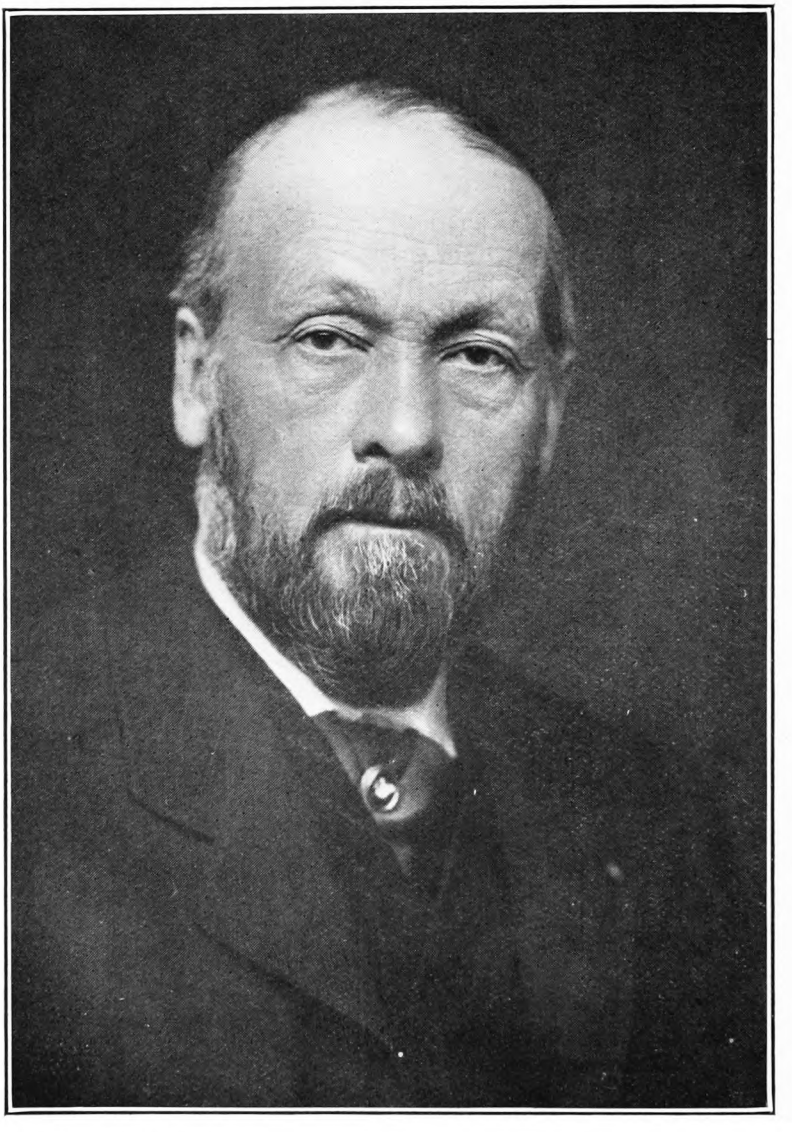
CO.	STATION.	In.	mm.	Per-cent. of Av	CO.	STATION.	In.	mm	Per-cent of Av.
Wigt.	Stoneykirk, Ardwell Ho	1·03	26	39	*Suth.*	Melvich School.....	3·78	96	126
,, .	Pt. William, Monreith .	·92	23	...	*Caith*	Loch More, Achfary...	8·37	213	127
Kirk.	Carsphairn, Shiel.	2·63	67	...	,, ..	Wick	2·25	57	99
,, .	Dumfries, Cargen.....	·61	15	16	*Ork .*	Pomona, Deerness	3·39	86	113
Dum	Drumlanrig	·65	17	17	*Shet .*	Lerwick	3·99	101	126
Roxb	Branxholme	1·02	26	39	*Cork.*	Caheragh Rectory	2·37	60	...
Selk .	Ettrick Manse.....	1·36	35	...	,, ..	Dunmanway Rectory.	3·40	86	58
Berk.	Marchmont House	1·36	35	65	,, ..	Ballinacurra	2·11	53	56
Hadd	North Berwick Res....	·78	20	50	,, ..	Glanmire, Lota Lo. ...	2·79	71	71
Midl	Edinburgh, Roy. Obs..	·61	16	39	*Kerry*	Valencia Obsy.	3·56	91	68
Lan .	Biggar	·69	17	29	,, .	Gearahameen	3·50	89	...
Ayr .	Kilmarnock, Agric. C..	·94	24	33	,, .	Killarney Asylum.....	3·21	81	61
,, .	Girvan, Pinmore.....	1·27	32	30	,, .	Darrynane Abbey	2·09	53	45
Renf.	Glasgow, Queen's Pk..	·51	13	17	*Wat .*	Waterford, Brook Lo..	1·49	38	46
,, .	Greenock, Prospect H..	1·16	29	21	*Tip .*	Nenagh, Cas. Lough...	1·45	37	46
Bute.	Rothesay, Ardencraig.	1·38	35	35	,, .	Tipperary	2·21	56	...
,, .	Dougarie Lodge	1·22	31	...	,, .	Cashel, Ballinamona ..	1·63	41	51
Arg .	Glen Etive.....	...	...	...	*Lim .*	Foynes, Coolnanes	1·83	47	57
,, .	Oban	1·29	33	...	,, .	Castleconnell Rec.	1·49	38	...
,, .	Poltalloch	2·00	51	48	*Clare*	Inagh, Mount Callan ..	2·50	63	...
,, .	Inveraray Castle.....	2·46	63	36	,, .	Broadford, Hurdlest'n.	1·76	45	...
,, .	Islay, Eallabus.....	2·33	59	56	*Wexf*	Newtownbarry	1·56	40	...
,, .	Mull, Benmore	...	...	...	,, .	Gorey, Courtown Ho...	...	...	...
Kinr.	Loch Leven Sluice	1·17	30	41	*Kilk.*	Kilkenny Castle	1·49	38	59
Perth	Loch Dhu	2·70	69	36	*Wic .*	Rathnew, Clonmannon	1·40	36	...
,, ..	Balquhidder, Stronvar.	1·59	40	22	*Cars.*	Hacketstown Rectory .	1·76	45	59
,, ..	Crieff, Strathearn Hyd.	·91	23	26	*QCo..*	Blandsfort House.....	1·50	38	56
,, ..	Blair Castle Gardens ..	1·38	35	...	,,	Mountmellick	·91	23	...
,, .	Coupar Angus School..	1·05	27	50	*KCo.*	Birr Castle.....	1·22	31	53
Forf.	Dundee, E. Necropolis.	1·09	28	58	*Dubl.*	Dublin, FitzWm. Sq...	·81	21	43
,, .	Pearsie House.....	1·95	49	...	,, .	Balbriggan, Ardgillan .	·48	12	24
,, .	Montrose, Sunnyside..	1·08	27	59	*Me'th*	Drogheda, Mornington	·44	11	...
Aber.	Braemar Bank	2·23	57	82	*W.M*	Mullingar, Belvedere .	·97	25	35
,, .	Logie Coldstone Sch. ..	2·03	52	98	*Long*	Castle Forbes Gdns....	1·82	46	64
,, .	Aberdeen, Cranford Ho	2·14	54	92	*Gal .*	Galway, Waterdale ...	1·31	33	...
,, .	Fyvie Castle	2·60	66	...	*Mayo*	Crossmolina, Enniscoe	...	...	...
Mor .	Gordon Castle.....	1·37	35	71	,, .	Mallaranny.....	2·77	70	...
,,	Grantown-on-Spey....	3·08	78	145	,, .	Westport House.....	2·10	53	53
Na .	Nairn, Delnies.....	1·26	32	70	,, .	Delphi Lodge	3·79	96	...
Inv..	Ben Alder Lodge	...	...	...	*Sligo*	Markree Obsy.	2·86	73	83
,, .	Kingussie, The Birches	1·75	44	...	*Ferm*	Enniskillen, Portora ..	1·88	48	...
,, .	Fort Augustus	1·59	40	38	*Arm.*	Armagh Obsy.	...	...	...
,, .	Loch Quoich, Loan....	9·60	244	...	*Down*	Warrenpoint	1·50	38	...
,, .	Glenquoich	8·35	212	81	,, .	Seaforde	1·24	31	41
,, .	Inverness, Culduthel R.	1·11	28	...	,, .	Donaghadee	·98	25	43
,, .	Arisaig, Faire-na-Squir	...	...	...	,, .	Banbridge, Milltown .	1·16	29	56
,, .	Fort William.....	2·82	72	38	*Antr.*	Belfast, Cavehill Rd. ..	1·16	29	...
,, .	Skye, Dunvegan.....	2·76	70	...	,, .	Glenarm Castle.....	1·92	49	...
,, .	Barra, Castlebay	1·87	47	...	,, .	Ballymena, Harryville	1·93	49	60
R&C	Alness, Ardross Cas. ..	2·63	67	80	*Lon .*	Londonderry, Creggan	2·29	58	72
,, .	Ullapool.....	4·00	101	...	*Tyr .*	Donaghmore	1·51	38	...
,, .	Torridon, Bendamph..	5·40	137	68	,, .	Omagh, Edenfel	2·53	64	85
,, .	L. Carron, Plockton...	3·43	87	...	*Don .*	Malin Head	1·60	41	66
,, .	Stornoway	3·04	77	68	,, .	Rathmullen.....	2·00	51	...
Suth.	Dunrobin Castle.....	...	...	...	,, .	Dunfanaghy	2·48	63	70
,, .	Lairg	3·92	100	...	,, .	Narin, Kiltoorish	3·26	83	...
,, .	Tongue Manse.....	3·21	81	92	,, .	Killybegs, Rockmount.	2·42	61	48

Climatological Table for the British Empire, September, 1923

STATIONS	PRESSURE		TEMPERATURE							Relative Humidity	Mean Cloud Am'nt	PRECIPITATION			BRIGHT SUNSHINE	
			Absolute		Mean Values				Mean							
	Mean of Day M.S.L.	Diff. from Normal	Max.	Min.	Max.	Min.	½ max. and min.	Diff. from Normal	Wet Bulb.			Am'nt	Diff. from Normal	Days	Hours per day	Percentage of possible.
	mb.	mb.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	%	0—10	mm.	mm.			
London, Kew Obsy.	1016·0	— 1·4	73	41	65·1	47·5	56·3	— 0·8	52·9	79	5·6	35	— 13	12	5·8	46
Gibraltar	1019·2	+ 3·4	84	54	75·5	64·8	70·1	— 2·1	64·7	75	5·0	35	— 1	6	...	...
Malta	1018·4	+ 2·7	87	66	79·4	70·8	75·1	— 0·1	69·3	73	3·5	13	— 17	2	...	...
Sierra Leone	1012·8	+ 0·2	88	70	84·4	72·5	78·5	— 0·7	74·3	81	7·3	628	— 97	27	...	...
Lagos, Nigeria	1012·3	— 0·5	86	70	83·5	73·6	78·5	+ 0·4	74·9	80	8·2	80	— 50	11	...	...
Kaduna, Nigeria	1015·5	+ 2·7	89	...	83·2	...	...	...	69·6	77	2·2	229	— 31	22	...	...
Zomba, Nyasaland	1013 4	— 0·4	89	52	82·2	59·3	70·7	+ 1·6	...	77	1·3	trace	— 9	1	...	...
Salisbury, Rhodesia	1014·6	— 0·1	92	41	83·0	49·9	66·5	+ 0·3	56·2	51	1·8	0	— 8	0	...	...
Cape Town	1019·4	+ 0·3	75	43	65·4	50·2	57·8	— 0·1	55·0	77	5·4	47	— 10	11	...	...
Johannesburg	1016·9	+ 0·5	89	38	74·7	50·1	62·4	+ 3·1	47·5	46	1·2	13	— 11	3	10·0	84
Mauritius	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Bloemfontein	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Calcutta, Alipore Obsy.	1005·5	+ 1·0	92	77	89·9	78·7	84·3	+ 1·3	79·4	86	6·4	133	—130	*8	...	...
Bombay	1007·1	— 0·9	87	73	85·0	76·8	80·9	+ 0·2	75·9	85	7·1	465	+190	*13	...	...
Madras	1005·8	— 0·7	101	71	94·2	76·8	85·5	+ 0·4	75·4	70	5·6	82	— 49	*6	...	...
Colombo, Ceylon	1009·8	+ 0·2	87	73	85·1	76·0	80·5	— 0·9	77·0	76	8·6	346	+220	24	4·7	39
Hong Kong	1008·2	— 0·1	90	73	85·9	77·3	81·6	+ 0·6	74·8	73	5·5	160	— 86	15	8·2	67
Sandakan	...	...	91	73	88·1	75·1	81·6	— 0·1	†76·6	†76	...	85	—154	11	...	...
Sydney	1008·8	— 7·2	86	44	70·3	50·9	60·6	+ 1·6	52·5	58	3·6	56	— 18	11	7·6	64
Melbourne	1008·4	— 7·4	74	37	60·9	45·2	53·1	— 1·0	49·4	69	6·0	58	— 3	21	5·0	37
Adelaide	1011·5	— 6·0	79	38	65·2	46·9	56·1	— 0·9	50·6	67	5·7	148	+ 98	14	6·3	54
Perth, W. Australia	1016·7	— 1·2	68	45	63·4	49·4	56·4	— 1·7	52·1	74	6·4	199	+114	21	5·8	49
Coolgardie	1014·7	— 2·4	86	36	69·6	44·7	57·1	— 1·5	50·1	42	3·7	3	— 12	4	...	...
Brisbane	1012·7	— 4·4	92	48	77·6	54·5	66·1	+ 0·8	59·1	53	2·0	31	— 21	4	9·4	79
Hobart, Tasmania	1002·7	— 8·0	67	35	58·3	43·0	50·7	— 0·1	45·7	67	6·6	78	+ 24	24	5·5	47
Wellington, N.Z.	1014·0	+ 0·5	65	35	58·8	46·0	52·4	+ 0·9	48·8	76	7·0	56	— 43	10	5·0	43
Suva, Fiji	1013·6	— 0·7	83	62	77·8	66·5	72·1	— 2·4	68·5	76	6·9	140	— 37	18	...	...
Kingston, Jamaica	1012·5	— 0·1	96	71	92·6	74·0	83·3	+ 1·8	...	65	5·0	3	—101	5	...	...
Grenada, W.I.	1013·1	+ 1·3	89	70	85·7	74·9	80·3	+ 0·1	75·9	76	4·2	118	— 87	21	...	...
Toronto	1018·9	+ 1·1	85	37	69·3	52·0	60·7	+ 1·5	54·3	78	4·3	68	— 13	12	...	...
Winnipeg	1014·3	— 0·5	87	27	70·7	47·0	58·9	+ 5·5	52·0	73	3·5	28	— 22	10	...	...
St. John, N.B.	1019·0	+ 1·5	73	41	62·5	48·0	55·3	— 0·6	51·1	83	5·5	67	— 28	8	...	...
Victoria, B.C.	1017·6	+ 1·1	81	45	66·5	50·2	58·3	+ 2·7	53·7	81	2·9	37	— 14	5	...	...

* For **Indian stations** a rain day is a day on which 0·1 in. (2·5 mm.) or more **rain has fallen.** † Mean of observations at 9h., 15h., 21h., from April, 1923.

To face page 49.



G. C. Beresford, Photographers.

A rainfall observer for sixty-seven years.

WILLIAM S. CLARK.

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The Propagation of Sound in the Atmosphere

By F. J. W. WHIPPLE, M.A., F.Inst.P.

SHORTLY after the termination of the War, Professor de Quervain of Zürich, suggested that the destruction of surplus explosives might be made to serve a good purpose by providing for explosions which could be made at set times and listened for by observers. In this way such theories as had been put forward in explanation of the anomalies of the propagation of sound in the atmosphere could be tested thoroughly. Professor de Quervain obtained the support of the International Commission for the Exploration of the Upper Atmosphere, and a Sub-commission was appointed at Bergen in 1921 to make such arrangements as should prove practicable. The first experimental explosion was produced at Oldebroek in Holland in October, 1922, and it has now been announced that there is to be a series of explosions during May, 1924, at La Courtine, on the Plateau des Mille Vaches, in the centre of France.

According to the interim report of the Sub-commission (presented to the International Meteorological Conference at Utrecht) the Oldebroek explosion was heard or registered instrumentally in south-east England, south Belgium, northern France, and, most unexpectedly, in Austria also. The "normal" zone of audibility reached only to a distance of 12 miles to the north-east and 40 miles to the south-west of the site of the explosion. Beyond the wide "zone of silence" the sound was heard at a distance of about 120 miles in the south-west and east. The greatest ranges at which records were obtained were about

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450 miles to north-west and 400 miles to west-south-west, and 350 to the south. These extreme ranges are greater than have been recorded for the audibility of natural explosions, with the outstanding exception of the eruption of Krakatoa, which was heard at 2,000 miles. The distance from La Courtine to the south coast of England is nearly 400 miles, so that, whilst it is very unlikely that the explosions produced there will be heard in this country, autographic records should be obtained. It would, perhaps, be practicable to use a device suggested* by M. Ernest Esclangon and recommended† by Professor Maurain. Esclangon uses a manometric flame: the jet, a short tube about 6 mms. in diameter, is mounted on the top of a petrol tin and ordinary lighting-gas is passed into the tin (presumably through another tube in the same cork) and out through the jet. The supply is adjusted to give a flame about 1½ inches high. Such apparatus is very sensitive to low sounds: it is anticipated that at 30 miles from the explosion the flame would be extinguished.

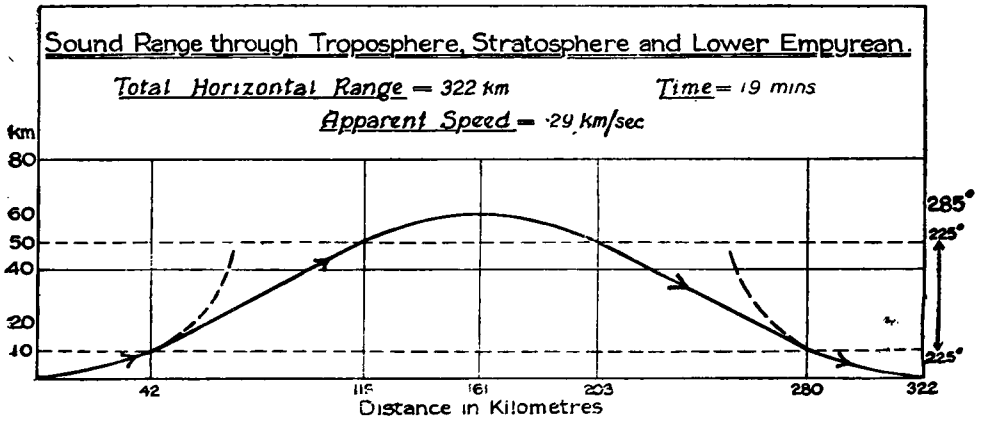
As to the theory of the curious disposition of regions of silence and audibility, which makes these experiments so interesting, some investigators have come to the conclusion that the phenomenon can be explained by the distribution of wind and temperature in the lower atmosphere. As a general rule, the information as to this distribution has been meagre. The advantage of direct experiment is that the conditions of the air up to reasonable heights can be determined at the appropriate time by appropriate observations. It is understood that in the case of the Oldebroek explosion Prof. van Everdingen finds that sound rays passing only through the lower atmosphere could not have reached some of the stations from which reports were received, notably those in England. The alternative explanation is that the sound traversed layers at considerable altitudes and returned to earth. The first theory of this kind was that of von dem Borne, who based his argument on the hypothesis that at great heights the principal constituent of the atmosphere was hydrogen, in which gas sound travels much faster than in ordinary air. The weakness of this theory lies in the fact that if such a hydrogen atmosphere does exist it must be so attenuated that the sonorous energy would be dissipated before it returned to earth. A more hopeful line of investigation was suggested‡ by the discovery by Lindemann and Dobson that the temperature of the part of the atmosphere where meteors become luminous was probably at least as high as that on the earth.

* *Paris, C.-R. Acad.sci.*, tome 178, 1924, p. 764.
† *La Nature, Paris.* 52 (1) 1924, p. 177.
‡ F. J. W. Whipple. *Nature, London*, Vol. 112, 1923, p. 759.

Consider the course of a sound-ray through an atmosphere with the following distribution of temperature and uniform composition :—

At the ground	285° A.	(54° F.)
Uniform lapse rate 0 to 10 km.		
At 10 km. up	225° A.	(—55° F.)
Uniform temperature 10 to 50 km.		
At 50 km. up	225° A.	(—55° F.)
Uniform negative lapse rate 50 to 60 km.		
At 60 km. up	285° A.	(54° F.)
Still higher temperature above 60 km.		

The velocity of sound being proportional to the square root of the absolute temperature, it can be shown* that if the curvature of the earth be negelcted the shape of the sound-ray in the lowest section (the troposphere) will be a cycloid. A cycloid is the curve described by a particle on the edge of a rolling wheel. In this case the surface on which the hypothetical wheel rolls is at the height 47·5 kilometres, the height at which zero temperature would be reached if the uniform lapse rate, 6° per kilometre, persisted. In the stratosphere the sound-rays are straight. In the region of transition from the stratosphere to the Lindemann-Dobson atmosphere (which L. F. Richardson would call the empyrean) the ray will take the form of a cycloid with the concavity downwards, and, in favourable circumstances, the sound will pass back to the lower regions. The diagram



illustrates the case in which the ray is horizontal at both ends. The total range is 322 km., or about 200 miles. In passing through the troposphere the sound goes 42 km. horizontally and 10 km. vertically. Then in the stratosphere it goes 77 km.

* Horace Lamb. *The Dynamical Theory of Sound*, p. 216.

horizontally to 40 km. vertically. The vertex of the path is reached in another 42 km. The path is symmetrical about the vertex. The sound takes 19 minutes to complete this journey, whereas, if it could have passed along the earth's surface with the uniform speed appropriate to the temperature 285° A., it would have taken 16 minutes and arrived 3 minutes earlier. Rays which are steeper at the ends will penetrate further into the Lindemann-Dobson region and have a shorter range, but there will be a minimum range determined by the fact that temperature in the empyrean has an upper limit. In practice the pressure of wind and the irregularities in the lapse rate in the lower atmosphere must complicate matters, so that a symmetrical distribution of sound around the source is not to be expected. Reconciling the observations and constructing a consistent theory will require much patience and laborious computation. Let us honour the meteorologists who have undertaken the task.

In conclusion may I express again my opinion that the simpler way of obtaining information as to the speed of propagation of sound through the upper atmosphere, and thereby as to its temperature, would be to send up rockets such as Professor Goddard proposes to shoot at the moon. There should be no great difficulty in making at 50 or 60 km. a bang that could be heard on the ground.

Sun-Pillar Observations—March 13th, 1924

To observers who watch the sky carefully sun-pillars are not very rare phenomena. On most occasions, however, a sun-pillar would not be noticed by the inexperienced. The observations made on March 13th are noteworthy in that the majority were recorded by persons who had never seen such a thing before. Attention was called to the matter by a communication issued to the newspapers on March 14th, and reports from nearly 100 points have been received at the Meteorological Office. These points have been indicated on the map. One report has been received which shows that a sun-pillar was to be seen in the West of Ireland at sunrise.

> MARKREE CASTLE, SLIGO. "Sun-pillar observed on the morning of the 13th at sunrise. Formed a blood-red streak reaching about 5° or 6°. This phenomenon was beautiful and lasted for about five minutes."

In London there was very thick smoke haze all day and it was easy to watch the bright red sun as the time of sunset approached. It was therefore remarkable that the sun-pillar

could be seen at all. The following observations were made near Turnham Green station.

> "The sun-pillar was first noticed at 5h. 45m., when it formed a whitish vertical streak equal in width to the sun and reaching up to 5° above it. The sun's disc was strangely distorted before it disappeared at 5h. 49m. As the pillar moved northwards it became patchy and assumed a pink shade. It was last seen through the smoke haze at 6h. 9m., ten minutes after the time given for sunset in the almanack."

The following notes extracted from other reports show how the phenomenon varied: the height of the pillar being estimated as 30° in some places, at 5° in others, and the colours passing through different sequences. These notes are arranged in the order of the latitude of the stations.

CLOUGHTON, NEAR SCARBOROUGH. The sun-pillar was seen here on Thursday and also on a previous evening (Monday or Tuesday). We realised its beauty and not its importance as a phenomenon. The colour was rose-pink streaked with primrose yellow.

FOULBY (WAKEFIELD). A white beam of light 15° in height at 6h. 5m.

CAISTOR, LINCS. White column of light. Estimated height 30° to 45°. The sky was practically cloudless save just on the horizon itself.

SPALDING. A pale yellow beam of light pointing right into the sky. A streak of cloud seemed to sever it from the sun.

CRANWELL. First visible 5h. 25m., disappearing at 6h. The pillar extended 20° above the sun and ended in a point. White in colour but not dazzling. There was a little glitter but this was not pronounced. Sky cloudless except one-tenth cirrus on west horizon.

BOSTON. Turner never painted a sky like it. If it were produced on canvas, people would think it overdone. The pillar was perpendicular and of a delicate apricot tint.

NORTHAMPTON. Whitish yellow, 5° high at 6h. 5m.

FORNHAM (BURY ST. EDMUNDS). Decidedly yellow.

COTTON (STOWMARKET). At 5h. 55m. a white streak in the centre of a beautiful pink to gold cloud.

HITCHIN. At 6h. it extended upwards at least 30°.

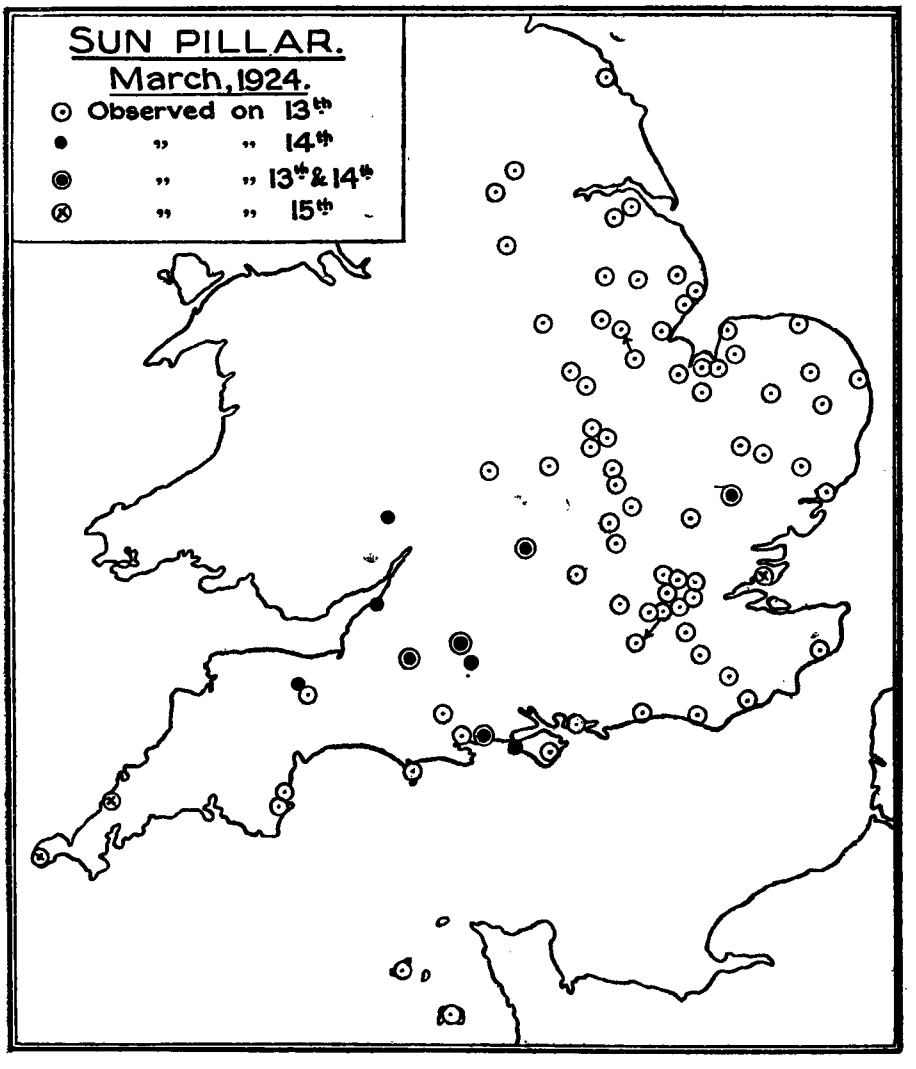
GOLDERS GREEN (LONDON, N.W.). Soon after 5h. 30m. it came out of the sun's disc like a tree trunk, red-orange in colour, turning to gold, and then whiter until the top was lost in smoky clouds.

WOKING. The pillar was slightly divergent, and visible quite 20° above the horizon.

OXTED. Visible 5h. 15m. to 6h. 30m.

HOVE. 5h. 45m. to 6h., white, then yellow, then rose-tinted.

HAYLING ISLAND. The sunset took the form of a huge deep-pink cross.



PAIGNTON. Though the blue haze of an east wind veiled earth and sea, the sky was crystal-clear save for the flimsiest of drifting vapours. The pillar sprang into being about six without apparent reason. It changed from pale gold to opalescent pink and apricot.

GUERNSEY. After sunset the pillar was broader and shorter and shining with a warmer orange-gold glow.

We have to thank Prof. van Everdingen and M. Besson for the information that no reports of sun-pillars seen on the day in question have been received by the meteorological services in Holland and France. In Holland the sky was cloudless all day.

There were a few places, Oxford, Bruton and Highcliffe, at which sun-pillars were seen on the 14th as well as on the 13th. At Bruton that of the 14th was the finer. Between Ross-on-Wye and Totland Bay, there were five places where the phenomenon was reported only on the 14th. In Cornwall it occurred on the 15th. From Sennen, near Land's End, Mr. Ernest Heath sends a sketch in which the pillar is seen as pink with a yellow background. (The picture shows " patches of blood-red on the sea " difficult to explain " as there appeared to be nothing above which reflected anything like the colour.")

The general explanation of sun-pillars is well known ; they are attributed to the reflection of light from the faces of ice-crystals. The analogy with the reflection of sunlight in the rippled surface of a lake is instructive. Such reflection gives a broad luminous path symmetrically placed with regard to the vertical plane through the middle of the sun. The parts of the reflecting surface are nearly horizontal : tipping, so to speak, fore and aft produces the length of the pathway, tipping transversely produces the breadth. It will be realised that the same amount of tipping is more effective in the one case than in the other, so that the apparent length of the pathway is much greater than its breadth. In the same way the dimensions of a sun-pillar are determined by the departure from the horizontal of the crystal faces from which the light is reflected. If when the sun is on the horizon the pillar reaches to an elevation 30°, there must be crystal faces making with the horizontal angles up to 15°. (The fact that on March 13th observers with experience in the measurement of angles estimated the height of the pillar as 30° is noteworthy. According to Pernter and Exner heights above 15° are exceedingly rare).

As to the form of the ice crystals which are responsible for the reflection which produces sun-pillars there appears to be no explicit information based on direct observation. On the other hand it is well known that the minute ice crystals, to which the name diamond dust has been given, are frequently in the form of flat hexagonal plates from $\frac{1}{2}$ to 1 mm. across. In Arctic regions such crystals fall slowly through the air without the sky being obscured. As they flutter downwards they will not remain horizontal. Some investigators suggest that the plates will mostly spin as they fall, but observations of other bodies falling in air or water suggests that the usual mode will be floating or oscillation about the horizontal. The growth of arms or spokes at the corners of the hexagons will have a steady-

ing effect. There is little doubt but that reflection of light from such flat crystals gives us sun-pillars.

As to the height above ground of the layer in which the diamond dust was prevalent on March 13th, and as to the depth of the layer, we are ignorant. It seems clear from the observers' reports that, though cirrus and cirro-stratus clouds were common, the sun-pillar was not formed by crystals in such clouds. Probably they were sparsely distributed through a great space. It may be added that over S. Farnborough an inversion of temperature was reported on March 13th, the readings being 39° F. at 3,100 feet, 45° F. at 5,200 feet. The freezing point was reached at 8,100 feet. This gives a lower limit to the height of the layer of reflecting particles. They cannot have persisted below 8,100 feet.

The question has been raised how frequently sun-pillars are to be seen in this country. Mr. Spencer Russell, who is making systematic observations of the characteristics of sun-rises and sunsets, has been so good as to communicate the following information based on his records during the last five years.

NO. OF SUN-PILLARS OBSERVED IN LONDON IN 5 YEARS.

	1919	1920	1921	1922	1923	Total
Sunrise ..	4	6	4	6	7	27
Sunset ..	4	5	3	8	11	31

	April	May	June	July	Aug.	Sept.	Total
Summer ½ year ...	4	10	8	4	3	2	31
	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Total
Winter ½ year ...	4	2	6	5	5	5	27

Twice during the five years sun-pillars were recorded at consecutive times of observation, (1) at sunset on April 21st, 1920, and sunrise April 22nd, and (2) at sunrise on December 24th, 1921, and sunset on the same day. In June, 1920, sun-pillars were observed at two consecutive sunrises.

Finally, let us note for future reference that on this occasion, at any rate, sun-pillars appeared in the middle of a spell of fine weather.

Discussions at the Meteorological Office

March 17th, 1924. *An aerological survey of the United States. Part I., Results of observations by means of kites.* By W. R. Gregg (M.W. Rev.: Supplement No. 20, Washington, 1922). *Opener*—L. H. G. Dines, M.A.

The paper under discussion is a valuable contribution to the study of the upper air. The results are not conspicuously different from those obtained in other parts of the north temperate zone.

March 31st, 1924. *Radiative Equilibrium; the Insolation of an Atmosphere.* By E. A. Milne (Phil. Mag., Vol 44, 1922, pp. 872-896). *Opener*—M. A. Giblett, M.Sc.

The paper which formed the subject for discussion at this meeting constitutes the second important advance which has been made in our theoretical knowledge of radiative processes in the atmosphere, particularly as bearing on the existence and maintenance of the earth's stratosphere, since the pioneer work of Gold in England and Humphreys in America, about the year 1908. Apart from the principal discovery, that the stratosphere can only be explained in a rational physical way when radiation processes are taken into account, the result of Gold's, which is of greatest interest in the present connection, is that the greater the amount of water vapour in the atmosphere, that is the greater its opacity to the long-wave atmospheric radiation, the higher must be the dividing level between the lower convective atmosphere and the outer shell which is in temperature equilibrium under the action of radiation alone; that is, the higher the tropopause. The observed latitude variation in the conditions of the stratosphere was thus explained, but the astonishing deduction followed, that the net outward flux of atmospheric and terrestrial radiation to space across the outer limit of the atmosphere must be actually less in equatorial regions than in higher latitudes. One assumption made in the investigation was that the atmosphere is "gray," *i.e.*, has, in each layer, an absorption coefficient the same for all wave lengths that are important. Gold suggested, without analysis, that the atmosphere is probably transparent in certain important spectral regions, thus allowing for the escape to space of extra radiation, so avoiding the necessity of accepting the above result.

Humphreys, in the course of his work, arrived independently at a useful relationship, which had been obtained earlier by Schwarzschild in connection with stellar atmospheres. Briefly, in its application to the earth's atmosphere, it is this: that,

neglecting direct absorption by the atmosphere of incoming solar radiation, the temperature, T_0, assumed by the outer layers of the atmosphere, is related to the "effective temperature," T_1, of the system earth plus atmosphere, by the simple relation $T_0 = T_1/\sqrt[4]{2}$. The "effective temperature" is simply the temperature of a "black" surface, or full radiator, which would yield a total radiation, per unit area, equal to that which the earth and atmosphere together deliver to space, across unit area of the outer boundary. The effective temperature, T_1, is actually about 254°, giving T_0, the temperature of the stratosphere, as 214°, in very good agreement with average observed values. It should be noticed that the above relation is quite independent of the way in which the absorption coefficient varies from layer to layer of the atmosphere.

The first important step taken after this early work, was by Emden in 1913. This paper was brought forward by Col. Gold at a Meteorological Office Discussion in March, 1921*. Emden asked the question: What temperature distribution would a stratified medium such as the atmosphere assume and maintain under the continual influence of radiant energy impinging from without on to its outer boundary? The application of Emden's work is restricted owing to his having taken the incident radiation as arriving uniformly from all directions instead of entering the atmosphere along rays at some particular inclination, so that he was not in a position to consider the effects of latitude. Now Milne asks a similar question, but removes this restriction and takes into account the angle of incidence of the solar beam. When the sun is in the zenith the greater part of the thermal energy gets through to the surface of the earth, and the atmosphere is heated from below. When the sun is near the horizon the greater part of the energy is absorbed before it reaches the surface of the earth and by this absorption the air gains heat. It is assumed that there is in each stratum of the atmosphere, one coefficient of absorption for long waves and another for solar radiation, the latter being only a fraction of the former, this fraction, which Milne calls n, having the same value at all levels.

Milne's answer to Emden's question is very striking. Interpreting the results in relation to the earth, it appears that the state of radiative equilibrium would be such that temperature at the outer boundary was quite independent of the absorption properties of the strata and is determined only by the solar constant, the latitude and the coefficient n.† From this outer boundary temperatures would increase inwards. The temperature assumed

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* *Meteorological Magazine*, Vol. 56, April, 1921, p. 68.

† This constitutes an important extension of the Humphreys-Schwarzschild case mentioned above.

by the earth's surface would be higher than that of the lowest stratum of air. It is clear that if other modes of heat transference than radiation were allowed to operate, convection would ensue; so that an atmosphere in strict radiative equilibrium throughout is not possible. Quite apart from this, the lapse rate of temperature for radiative equilibrium might exceed the dry adiabatic rate (as indeed Emden showed it would up to 3 km. in the case he considered), giving an extra reason for convection in the lower atmosphere.

On the poleward side of a certain critical latitude, conditions are reversed, temperature appropriate to radiative equilibrium decreases as the earth's surface is approached, and the surface itself is colder than the air in contact with it. In the critical latitude, conditions are isothermal throughout. If solar radiation were absorbed as readily as atmospheric this latitude would at the equinox be 45°. Greater transparency to solar radiation displaces the critical latitude rapidly towards the pole.

Milne wishes to insist principally on the general theory, any application being made only tentatively and being valid only within the range of the assumptions made.

The chief application is to the latitude variation of conditions in the stratosphere. In the work outlined above, the temperature of the equatorial stratosphere comes out much higher than that in higher latitudes, which is contrary to observation. The greater obliquity of the incident solar beam in high latitudes does indeed make the difference between the temperature at the equator and at the poles less in the stratosphere than lower down in the atmosphere, but it by no means reverses its sign. It is suggested that on account of the relatively greater importance of carbon-dioxide compared with water vapour the coefficient n may be greater in high than in low latitudes. This would further reduce the contrast.

But to obtain a cold equatorial stratosphere and a warm polar one it becomes necessary to suppose that some of the solar energy incident in equatorial latitudes is re-radiated to space in higher latitudes, *i.e.*, the general circulation of the atmosphere must be brought in, and, indeed, to such an extent as to lead to the same result, as Gold obtained, viz., that the earth and atmosphere together return to space less radiation in low latitudes than in high.

Observations gave us the paradox that the higher atmosphere was colder over the equator than over the poles; theorists now agree in presenting us with another paradox, the strongest radiation into space is from the coldest parts of the globe. The search for a complete explanation of these paradoxes is one of the most fascinating tasks before meteorologists.

M.A.G

Royal Meteorological Society

THE meeting of the Society held on Wednesday, March 19th, at 49, Cromwell Road, South Kensington, was devoted to the customary March lecture ; Capt. C. J. P. Cave, President, in the Chair.

Professor V. D. Blackman.—Atmospheric Electric Currents, normal and abnormal, and their relation to the growth of plants.

The first part of the lecture was devoted to the history of the subject. Reliable determinations of the effect of electric conditions on the growth of plants are difficult as the elimination of other factors is only possible when the experiments are numerous and statistical methods can be used. In the earlier experiments this was not clearly understood, and accordingly divergent results were obtained and the optimistic claims of one author could not be upheld by the next. In recent years field experiments, made with all precaution at Rothamsted and other agricultural stations, have shown that a small but definite increase of the crop is found when cereals such as oats are given daily doses of electric current. Professor Blackman and his collaborators recognised, however, that they were working in the dark in varying the strength of the dose and the time at which it should be given and that it would be more economical to work on a small scale, growing plants in pots with all the conditions under control. The new experiments have shown that the best results are obtained with exceedingly small doses and that the susceptibility of the plants varies at different stages of growth. In the latest experiments a single plant is under observation, a barley plant a few hours old : it is found that if the electric current is given for half an hour the effect of the stimulus is shown by more rapid growth during the next ten hours.

Whether the changes in the natural electrical state of the atmosphere produce any effects on plants is still an open question : but the growth of knowledge of the action of artificial stimuli will no doubt provide an answer before long.

Aeroplanes have been used to obtain information and to prevent further loss of life on the banks of the Vistula, where near the end of March more than 40 villages were under water and several bridges have been carried away. Icedams, which had formed across the river owing to the sandbanks, have been broken up by artillery fire.—*Daily Mail.*

Correspondence

To the Editor, *The Meteorological Magazine*

The Long Arm of Coincidence

I WAS interested in the paragraph appearing under the above heading in the February number of the *Meterological Magazine.* May I give further instances; this time concerning the element of bright sunshine. At Ross-on-Wye in 1922 the total sunshine was 1,454 hours; in 1923, 1,455 hours: the figures in each case being rounded off to the nearest whole number by the Air Ministry. The actual difference between the two totals is about half-an-hour! Again, the sunshine registered here in February, 1924, was 62·8 hours, and in January, 1924, 62·7 hours! A year ago the February total was 63·3 hours; roughly, 63 hours in each instance.

F. J. PARSONS.

County Observatory, Ross-on-Wye, March 6th, 1924.

Another curious example of the above. On January 1st, 1915, I measured at 9 a.m. the December rainfall 6·20 in., the highest I had recorded since 1880, when I began observing at Colwyn Bay. On January 1st, 1916, I measured 6·18 in.! And it began to rain while I was measuring, so that in a few minutes it would have been exactly the same for 1914 and 1915.

ALFRED O. WALKER.

Ulcombe, Kent, March 20th, 1924.

[The instances quoted by Mr. Parsons and Mr. Walker show how the meteorological conditions of one year may resemble those of another without the recorded figures tallying exactly. If there is a group of 100 stations at each of which the difference between the rainfalls of two consecutive years is less than 1 inch, then it is highly probable that at one station the difference recorded will be zero. To the observer at that station it is a remarkable coincidence, to the statistician it is a commonplace.—ED. *M.M.*]

The Severe Winter in Greece

I HAVE recently seen in the newspapers notices of very severe weather lately experienced in Greece, of heavy snows, of a train snowed up between Athens and Thebes (in some mountain pass, I presume): and I have just heard from an old friend at Patras, who has lived there nearly 60 years, that the winter has been the most severe that he has known; but he does not give any figures.

It happens that just 50 years ago, in February and March, 1874, I was recording at Patras some very low temperatures. These were published in the *Quarterly Journal of the Meteorological Society* in July, 1877. I may quote as follows :—

> 1874. *Snow.* On the morning of Feb. 2 snow lay alike on mountain and plain all round, all but down to the sea level, and snow flakes fell that afternoon in the streets of Patras. Snow fell again in the town in the afternoons of Feb. 5 and 11 ; on the latter of these days in prodigious quantities among the mountains. Flakes fell again on March 1 and 4, and on March 5 snow fell heavily on the deck of a steamer between Zante and the Morea. On March 7 a climax was reached with light wind, brilliant sunshine and wonderfully transparent air—ground at all sheltered from the sun as also my wet bulb thermometer continued hard frozen all day"

Little as would be thought of this " worst " in England, be it remembered that for a seaside station in the Mediterranean, in latitude 38°, this was intense severity. Not only was the havoc fearful among the flowers, hedges of geranium, etc., but scarce a lemon tree escaped. Old trees had to be cut down to mere stumps and the next autumn lemons cost nearly as much in Patras as in London !

H. A. BOYS, F.R.Met.Soc.

Spring Hill, S. Mary Bourne, Andover. March 5th, 1924.

Long Records

" I notice in the Obituary, in the 1922 volume of *British Rainfall,* the death of Rev. John Dene, who had a record of 50 years' rainfall, and that you only know of one living observer (Sir John Moore) with so long a record. Further, that the late Mr. Dalgleish kept a record of 57 years. As I began in June, 1863, and have completed 60 entire years, 1864-1923, I flatter myself I have done still better.

" I have worked out my 60 years' averages and find most months fairly in agreement with the 1881-1915 averages. Jan., May and Sept., however, come out 10 or 12 per cent. higher, and June lower. My first 10-year average gave Jan. as high as 3·31 in. and May 2·28 in., June on the other hand only 1·38 in., and my last 10-year average puts June down to 1·07 in. and Dec. up to 3·82 in."

J. ELLIS MACE.

View Tower, Tenterden, February 2nd, 1924.

[We are glad to take this opportunity to congratulate Mr. Mace on his record and to mention that there is at least one observer whose observations cover a longer period than his—Mr. W. S. Clark, whose portrait appears in this issue of the *Meteorological Magazine.*—ED. *M.M.*]

Visibility and Convection

ON p. 436 of "Forecasting Weather" (second edition), Sir Napier Shaw says: "On the other hand, cyclonic weather with its strong convection is from that point of view good for seeing, and the appearance of cumulus clouds in the sky ought to be a good sign, as showing that there is at least some convection there."

I have examined the relationship between upward convection currents from the ground and the degree of horizontal visibility, using the summers (the six months from April to September) of 1920 to 1923 (inclusive), and the observations made at Cranwell, Lincolnshire. The results may not be without interest.

The visibility observations made each day at 13h. were classified under three headings:—

(A) Those in which the visibility was 13 miles or more, termed hereafter "good or very good,"

(B) Those in which the visibility was $2\frac{1}{4}$ miles or over, but not reaching 13 miles, termed hereafter "indifferent or fair,"

(C) Those in which the visibility was less than $2\frac{1}{4}$ miles, termed hereafter "bad or poor,"

and then further classified as to whether or no convection was present, as determined by the existence of cumulus or cumulonimbus cloud at the time of the visibility observation.

The results are shown in the following Table:—

Cu. or Cu-Nb.	Total No. of obs.	GROUND VISIBILITY.		
		Good or very good	Indifferent or fair	Bad or poor
Present	467	41 %	59 %	0.2 %
Absent	265	21 %	75 %	4 %

A consideration of this table seems to justify the belief that convection days are more likely to be accompanied by good or very good visibility than are non-convection days, and are very unlikely to be accompanied by bad or poor visibility.

W. H. PICK.

R.A.F. (Cadet) College, Cranwell, Lincs., March 6th, 1924.

[It is to be hoped that such analysis as has been undertaken by Captain Pick will be carried further. It is not entirely satisfactory to class with the days of no convection those with a cloudless sky when distant objects are "all a-shimmer in the haze."—ED. *M.M.*]

OFFICIAL NOTICES

The Height of Low Clouds

INFORMATION as to the height of the lowest clouds is of great importance in the navigation of the air. Such information has been included in meteorological telegrams for some years, having been introduced in the British Army in France during the War. It is usually obtained either by a pilot balloon observation or by estimates based on experience with such observations.

It has now been arranged that at the stations where a professional staff is maintained by the Meteorological Office, the height of the cloud at each of the daylight hours of observation in the standard scheme, viz., 7h., 13h. and 18h. G.M.T., shall always be determined either by a pilot balloon or by sending up a smaller balloon specially for the purpose.

Reports of Cloud Amounts

THE Meteorological Conference at Vienna in 1873 resolved that "The degree of cloudiness is to be given by the figures 0-10, in which 0 is to represent a sky quite free from cloud, and 10 an entirely overcast sky." This resolution has not always been set out sufficiently clearly in instructions to observers, who have consequently been in doubt as to what was the appropriate entry on occasions when the sky was almost, but not quite free from cloud, or almost, but not quite overcast. Instructions have recently been issued to the observers of the Meteorological Office which may be summarised as follows:—

In every case when there is cloud present the fact must be reported. The entry 0 for cloud must only be used when the sky is quite free from cloud. Where a very small amount of cloud occurs it should be reported as amount 1, so that 1 is to be interpreted as meaning some cloud and not more than three-twentieths of the whole sky. At the upper end of the scale of cloud amount the rule is that in every case when there is any clear sky visible the fact must be reported. Cloud amount 10 must only be used when the sky is quite overcast with no patches of clear or blue sky visible at all. If cloud covers more than seventeen-twentieths of the sky and does not completely cover the sky it is to be counted as amount 9. These instructions are to be read in conjunction with the decision* that when the whole sky is covered by a thin veil of cloud, through which the sun or the stars can be seen faintly, the cloud amount is 10.

* *Meteorological Magazine*, Vol. 57, 1922, p. 267.

NOTES AND QUERIES

The Government's Appreciation of the Work of Meteorological Observers

In introducing the Air Estimates in the House of Commons on March 11th, 1924, the Under-Secretary of State for Air (Mr. Leach) referred to the Meteorological Service in the following words :—

" MAY I say a word now about a Department of which I am rather proud ? By arrangement made some five years ago, the Air Ministry provides the meteorological service of the whole country. The importance of this Department is not sufficiently realised. The public thinks of it in terms of daily newspaper weather forecasts, but its chief work is connected with aviation, shipping, agriculture, public health, and military and naval services. It is a mighty and beneficial international engine. Co-operative observations are taken simultaneously all over Europe. These are collected at a few centres and broadcasted by wireless telegraphy. Almost at once every meteorological office in Europe knows weather conditions from Spitzbergen to Cairo, and from far out in the Atlantic to Ekaterinburg. As an instrument for prevention of accidents in aviation, it is a splendid life-saving agency. Moreover, 4,000 public-spirited observers all over the country supply us voluntarily with rainfall records ; 255 of our 306 climatological stations are maintained at the cost and trouble of scientifically-minded private citizens ; and 500 scientific officers on board our merchant ships supply us with observations from all parts of the world. Our own staff is only 270 alert, competent people doing valuable scientific work. Our debt, therefore, to this voluntary army of public-spirited people is incalculable, and may I take this opportunity of expressing the gratitude of Parliament to them ? In two Votes £119,000 is put down for this work. After deducting receipts, £12,500, the net cost is £106,500—a remarkably cheap and productive investment."

Radiation from the Atmosphere.—A Correction

IN the note on Professor Vegard's hypothetical nitrogen nuclei in the last number of the *Meteorological Magazine* the statement was made that the radiation which left the atmosphere was in the main emitted by the stratosphere, " a source at about 220° A." This statement is not justified : it is probably true that little of the radiation from the ground escapes without being absorbed by the water vapour in the air, but it must not be forgotten that the water vapour is itself radiating. When radiative equilibrium is reached every layer re-emits all the

energy it absorbs, the net flux then being the same through all layers. It cannot therefore be said that the radiation which passes out of the atmosphere originated in any particular layer.

The net flux is equal, however, to the total radiation from a black body at about 254° A., and a small black sphere subject to such radiation from one direction would reach a steady temperature $254° \div \sqrt[4]{2}$ or 214° A. It is hardly necessary to add that this amendment of the argument increases the difficulty in accepting Vegard's hypothesis.

The Parkin Prize

THE following notice has been received from Dr. J. S. Fowler, Secretary of the Royal College of Physicians of Edinburgh :—

> In terms of the Bequest made to the Royal College of Physicians of Edinburgh by the late Dr. John Parkin, Fellow of the College, a Prize is offered for the best Essay on certain subjects connected with Medicine.
>
> The subject of the Essay for the present period is, in the terms of the deed :—
>
> > "On the effects of volcanic action in the production of epidemic diseases in the animal and in the vegetable creation, and in the production of hurricanes and abnormal atmospherical vicissitudes."
>
> The prize is of the value of One Hundred Pounds, and is open to Competitors of all Nations.
>
> Essays, which must be written in English, must be received by the Secretary not later than December 31st, 1924. Each Essay must bear a motto, and be accompanied by a sealed envelope bearing the same motto outside and the author's name inside.
>
> The successful Candidate must publish his Essay at his own expense, and present a printed copy to the College within three months after the adjudication of the Prize.

We understand that only twice when Volcanic Action has been the subject set for the Parkin Prize has an award been made. In 1900 the prize was divided between W. G. Aitchison Robertson and Noel Dean Bardswell, and in 1913 H. J. Johnston-Lavis was the prize winner. The publishers of the three prize essays were G. R. Hamilton, Edinburgh, the *Edin. Medical Journal* (Oct. 1901), and J. Bale, Sons and Danielsson, London, respectively.

We regret to learn of the death on March 16th of M. Alfred Angot, late Director of the Central Meteorological Bureau, Paris, and for many years a member of the International Meteorological Committee.

A Rainfall Observer for Sixty-seven Years

MR. W. S. CLARK, whose portrait we are glad to reproduce in this number of the *Meteorological Magazine*, is the senior observer reporting to the British Rainfall Organization. He started rainfall observations in 1857, being then nineteen years old. He was then living in the centre of the Village of Street, Somerset. He has moved twice, to the next house in 1866, and in 1890 to his present residence three-quarters of a mile from the village; otherwise the rainfall observations for the whole period are homogeneous; they have appeared regularly in *English Rainfall* and its successor *British Rainfall* from 1860 onwards. It is to be hoped that the complete set of monthly totals will be published.

Jan Mayen

A FURTHER extension of the activities of the Norwegian Meteorologists stationed on the Island of Jan Mayen was indicated on March 18th, when for the first time reports, giving the upper winds as determined from observations of pilot balloons sent up on the island, were received in this country from Norway in wireless messages. Two ascents were made on that day, the first reaching 6,500 ft., the second nearly 20,000 ft.

The reports from Jan Mayen, which it will be remembered is in latitude 71° N, well within the Arctic Circle, have already proved of great value to the forecasting service.

Meteorological Free-Ballooning in the United States

BELIEVING that the scientific possibilities of the manned free balloon have not been exhausted, the United States Weather Bureau, in co-operation with the Army Air Service, is undertaking a series of flights for meteorological purposes. It was arranged that these flights should take place during the months of April and May, the starting point in each case being Scott Field, Illinois, the Army's large lighter-than-air post near St. Louis, Missouri. The balloons are of the standard training type, 35,000 cubic feet capacity, and filled with hydrogen. Two men are to make the flights—one an Air Service officer, to act as pilot, and the other the representative of the Weather Bureau.

Dr. C. Le Roy Meisinger, who has been nominated by the Chief of the Weather Bureau to represent the Bureau on these flights, has been so good as to write out for the *Meteorological Magazine* the following notes on his programme.

While there are several objects in making these air voyages, particular attention will be given to the determination of free-air trajectories from the course taken by the balloon riding at relatively constant elevations. The problem resembles that

studied by Shaw and Lempfert with respect to surface air, and published as *The Life History of Surface Air Currents*. It is recognised that convective effects may, in some cases, act as a deterrent to the attainment of this object; but, in general, it is believed that a fair representation of the path of a given mass of air can be obtained in this way. It is required, therefore, to know as accurately as possible the horizontal trajectory of the balloon itself. This affords little difficulty when the ground can be seen; but when the earth is obscured by clouds recourse will be had to dropping attractively colored postcards, speeded by small lead weights, which may be picked up and mailed. These cards contain spaces to be filled in by the finder showing the place and time of finding. Astronomical observations of position above clouds by means of an aircraft sextant will also be made when circumstances require.

A number of stations in the United States have been provided with tables for the reduction of barometric pressure to levels 1 and 2 kilometres above sea-level, according to a method recently developed*. Trajectories of air worked out upon the basis of these charts, and gradient wind relations, will be compared with those determined by observation from the balloon.

An Owens Dust Counter will be carried, at the suggestion of Dr. H. H. Kimball, who has had charge of the atmospheric dust observations in the United States, agreed upon internationally at the Rome meeting in 1922. Also, observations of sky brightness at several points in the sky will be made by means of a Holophane Lightmeter—a commercial portable photometer. Aside from the carrying of a carefully calibrated and accurate barograph (in addition to the usual balloon instruments) and an Assmann aspiration psychrometer—the latter principally for temperature observations—little attention will be paid to the observation of the vertical distribution of meteorological elements, for kites and pilot-balloons are in daily use at a number of stations, and it is believed that their testimony is of a higher order of accuracy than is obtainable in a manned balloon.

Some attempt will be made to measure the size of water droplets in clouds by means of the measurement of the angular diameter of coronas formed about small electric lights. But since preliminary experiments have not been wholly satisfactory, further trials must be conducted before good results are assured, and these trials can best be made actually in the clouds.

Close liaison will be maintained between the balloonists and the forecast officials in Washington. The latter will be informed

*MEISINGER, C. LEROY: The preparation and significance of free air pressure maps in the Central and Eastern United States. *Monthly Weather Review Supplement, No.* 21. Washington, 1922.

at all times of the departure and landing of the balloonists; and, while the balloon is in the air, special weather bulletins will be broadcasted by radiotelephone from several commercial broadcasting stations that have volunteered to co-operate. The balloon will be equipped for radio reception, but not for transmission.

The High Fog in London on January 23rd, 1924

JANUARY 23rd was marked by a smoke fog of an abnormal character in London and surrounding districts. The amount of impurity registered by the automatic filters in Westminster and South Kensington was not unusually large, but a thick bank of smoke overhead seriously obscured the daylight in most parts of London, light conditions about mid-day being similar to those during the night.

In Westminster the really abnormal conditions commenced at about 11 a.m., before which time the morning was dull and the sky overcast. From 11 a.m. to 1 p.m. light failed gradually until the whole of the sky visible from the window of Dr. Owens's Office in Victoria Street was completely black, the darkness appearing to spread from a northerly direction: nevertheless, shop window lights could be readily seen in the street approximately a quarter of a mile away, indicating that surface visibility was still comparatively good.

At 1.10 p.m. the sky towards the north became slightly luminous and of a rosy colour, but the south was still black. From this time the sky cleared from the north. About 1.30 p.m. an intermittent noise very much resembling distant thunder was heard. During the next few minutes the light improved considerably. At 1.45 p.m. a shower of very fine rain commenced, and clouds of white mist could be seen blowing past the Victoria Street buildings towards the south. Conditions then came back practically to normal, with some fluctuations apparently caused by the indeterminate wind which arose. About 1.55 p.m. there was a particularly bright period, but at 2.5 p.m. the sky in the north had darkened again. At 3.5 p.m. the haze was white, rain was falling steadily, the wind was very indefinite, and the sky was lighter. As the daylight failed towards evening, conditions seemed to follow exactly those experienced from 11 a.m. onwards, and at 5.35 p.m. everything appeared the same as at 1 p.m.

Enquiry as to the limits of the area affected by the high fog have been made through various channels. It appears that fog did not extend to the north of Finchley Road. In the south some fog was general, but the extent to which it partook of the special character observed at Westminster cannot be deter-

mined. The amount of smoke in the air as measured by the air-filter was not exceptional. At Westminster the maximum for the day, 7 milligrams per cubic metre, occurred as early as 9.50 a.m. During the dark period the amount was about 4 mg/m^3. At South Kensington the amount was only 2 mg/m^3.

The circumstances in which this high fog developed have not been determined in such detail as would enable us to answer with any confidence the question why it occurred. It is unfortunate that no observations of upper air temperature over England were secured. There were observations in the Low Countries, but these were made in an air current from the east, whereas the air over south-east England was drifting from the north. It was air which had travelled from the south, having left the Atlantic two or three days previously and traversed Spain and France. It had almost come to rest during the night January 22nd-23rd. There is some evidence that the air at such heights as 3,000 ft. had left the Atlantic further south than the surface air, and therefore that it probably contained more water vapour. The current of cold air from the Continent touched the east coast of England but it did not reach London, where temperature was very steady, rising only from the night-minimum of 44° F. to the day-maximum of 45·5° F. This steadiness is to be attributed in great part to the presence of a layer of low stratus cloud: the height of the cloud was given at several stations as about 200 feet. It would seem that as the cloud drifted slowly over London it was contaminated by the smoke and that the smoke-laden cloud cut off the daylight. There seems to be no direct experimental evidence that a cloud of dirty drops cuts off more light than a cloud of clean drops, and, indeed, it is not known that smoke does mix with the water of minute drops. On the other hand in this case the light seems to have been cut off much more effectively than it would have been by two separate screens, one of cloud, the other of smoke.

The essential features of the phenomenon appear to be:

(*a*) Very slight air movements.

(*b*) Persistent low cloud.

The Demand for a Clean Atmosphere

THE Annual Meeting of the Coal Smoke Abatement Society was held at the Royal Society of Arts on March 26th. Lord Newton, who presided, insisted on the bad effects of smoke on the health of the community, and on the unnecessary labour involved in the removal of the soot deposit which in the case of London amounted to 300 tons a year. Mr. G. B. Shaw made a forceful speech. Some of his points were: "London is chock full of beautiful things but unfortunately we have not light to see them,

because of the smoke and fog and grime. I know Englishmen always like to be washing, but, as an Irishman, I dislike it intensely. Yet, in London, I am always washing my hands." What was required was a sort of civic consciousness in the matter. No mediæval person would live in our modern disgraceful towns. Sir Napier Shaw recalled with satisfaction the progress that had been made in the problem of providing pure water. Recollections of the sacrifice of valuable lives had stimulated the efforts to obtain pure water. Was it needful for lives to be publicly offered in sacrifice in order to achieve pure air? Was not the obvious sacrifice of comfort, health and vigour enough? As to the mode of remedying the nuisance the difficulty was that statutes of prohibition raised as many obstacles as they removed. The right way was to find some means of making it worth while for the landlord, the tenant and the household to agree among themselves upon arrangements for the avoidance of smoke. Dame Helen Gwynne-Vaughan and Dr. H. A. Des Vœux also spoke.

On April 3rd a deputation, headed by Lord Newton, waited on Mr. Wheatley, the Minister of Health, to urge the need for legislation to secure smoke abatement. The Minister promised to facilitate educational work and to give sympathetic consideration to the request for the early introduction of a Bill in Parliament.

One of the ways in which the smoke problem may be solved is shown by the issue of the prospectus of "Leigh Smokeless Fuels, Limited." This company has been formed to work processes patented by Mr. E. R. Sutcliffe for making from coal dust a fuel with all the virtues of anthracite. To quote from one of the testimonials in the prospectus, "The fuel is wanted and wanted now."

News in Brief

Sir Napier Shaw will deliver a course of five lectures on Radiation at the School of Meteorology, South Kensington, during the summer term. The lectures will be on Fridays at 3 p.m., beginning on Friday, May 9th, 1924. Anyone wishing to attend should apply to the Registrar, Imperial College of Science and Technology, South Kensington, S.W. 7. The fee for the course is 15s.

The synoptic messages issued by wireless telegraphy from Rome have been expressed in the new International Code since February 21st, 1924. Since March 2nd the times of issue have been considerably accelerated. The morning message is now issued at 8h. 50m. and the evening message at 19h. 50m. G.M.T.

It is announced that Boris Weinberg, Professor of Physics at the University of Tomsk from 1905 until recently, has been appointed Director of the Russian Central Physical Observatory. He is best known for his share in the Magnetic Survey of Siberia, but he has also done a good deal of work on anchor ice, surface tension and the formation of snow crystals.

The Weather of March, 1924

FOR the first four or five days of the month the air supply over the British Isles was drawn from the Arctic regions and northern Europe, and temperature fell even lower than in February. On the 3rd a minimum of 2°F. in the screen and of —2°F. on the ground was recorded at Balmoral. Snow and hail occurred at several places, and in many parts of the country snow lying to a depth of several inches was reported. Pressure rose quickly over England and the adjacent parts of the continent about the 6th of the month, and, with the change to fine sunny weather, there was a gradual increase in day temperatures, 63°F. being recorded at Killarney on the 15th. The nights, however, continued cold and thermometers exposed on the grass frequently fell below 20°F. As an instance of the persistence of cold weather it may be mentioned that at Copdock, Ipswich, the grass minimum thermometer gave readings of 32°F. or below on each of 39 nights from February 12th to March 21st inclusive. Sunshine records were repeatedly good, and during the first three weeks 9 or 10 hours were registered on most days in some part of the kingdom. Such conditions when combined with light winds naturally favoured a wide daily range of temperature; ranges of 30°F. and even 40°F. (S. Farnborough on the 15th) being recorded in some parts of England. At the same time at one or two places, notably in Scotland and Ireland, the conditions were cloudy and the range only amounted to 2°F. or 3°F. Little rain fell between the 6th and 20th, and in some parts of England there was an absolute drought during this period. After the 20th, however, depressions from the Atlantic spread across the British Isles and south-westerly winds with mild rainy weather prevailed in the south; on the 22nd 41mm. were recorded at Treherbert (Glamorganshire) and 37mm. at Llyn Fawr Reservoirs (Glamorganshire). In the north snow or hail occurred. During the last week winds were between E and NE and the weather cold and cloudy with showers of hail or sleet in places. At Ilderton (Northumberland) the total rainfall for the month only amounted to 7mm.; at Parson Drove, Cambridgeshire, to 9mm. The duration of bright sunshine exceeded 180 hours in some districts, while Teignmouth reported 187 hours, a "record" there for March.

The avalanches which were reported on numerous occasions during the past winter in Central Europe continued during March, many reports of damage and loss of life having been received from various parts of Europe; they were especially serious at Salzburg in Austria and in Switzerland. Towards the end of the month a sudden thaw following on heavy snowfall resulted in extensive floods which caused much suffering and damage in Poland, and were responsible for the bursting of a newly-built dam in Jutland. The Vistula continued to rise until the end of the month. In some places the river was 27 ft. above the normal level, a height said not to have been recorded since 1570.

On account of torrential rain, numerous rivers in Spain and Portugal have overflowed their banks and many people have been drowned. At the end of the month a series of landslides, caused through exceptionally heavy rainfall occurred at Amalfi, Italy, and many lives were lost. In consequence of the recent heavy rain in Sinai, the railway bridge at El Arish has been washed away.

The United States were visited by two destructive storms during March. The first, on the 11th, swept the whole Atlantic seaboard, isolating Washington for hours by damaging the overhead telephone and telegraph wires and interrupting wireless operations. The second, which lasted throughout the 28th and 29th, visited chiefly the Central States. At St. Paul, in Minnesota, 18 inches of snow is said to have fallen in 24 hours. The lowlands of Ohio were flooded, and much damage done in Maryland, Pennsylvania and West Virginia.

A serious accident was caused near Bareilly (India) through a train being struck by a violent wind when crossing a bridge. The train fell into the river and many lives were lost.

The special message from Brazil states that rainfall was excessive in the north, the monthly average being 109 mm. above normal. Floods occurred in many places. In the central districts the average was 10 mm. above normal. In the south the rainfall was irregular, with an average 50 mm. under normal. Temperature was generally below normal in the north and irregular in the central and southern districts. The coffee, cotton and cocoa crops are in good condition. At Rio de Janeiro the average pressure and temperature were about normal.

Rainfall March, 1924: General Distribution

England and Wales	58	per cent. of the average 1881-1915.
Scotland	40	
Ireland	41	
British Isles	50	

Rainfall: March, 1924: England and Wales.

CO.	STATION.	In.	mm.	Per-cent. of Av	CO.	STATION.	In.	mm.	Per-cent. of Av.
Lond.	Camden Square.....	·73	19	40	*War.*	Birminghm, Edgbaston	·93	23	49
Sur .	Reigate, Hartswood...	1·52	39	69	*Leics*	Leicester Town Hall...	·67	17	...
Kent.	Tenterden, View Tower	1·74	44	81	,, .	Belvoir Castle.....	·54	14	30
,, .	Folkestone, Boro. San.	1·03	26	...	*Rut .*	Ridlington.....	·72	18	...
,, .	Broadstairs	1·01	26	60	*Linc.*	Boston, Skirbeck	·69	17	44
,, .	Sevenoaks, Speldhurst.	1·56	40	...	,, .	Lincoln, Sessions House	·79	20	51
Sus .	Patching Farm.....	1·77	45	82	,, .	Skegness, Estate Office.	·57	15	34
,, .	Eastbourne, Wilm. Sq.	1·92	49	85	,, .	Louth, Westgate	·65	17	31
,, .	Tottingworth Park....	2·05	52	82	,, .	Brigg	·97	25	53
Hants	Totland Bay, Aston...	1·72	44	82	*Notts.*	Worksop, Hodsock....	·87	22	51
,, .	Fordingbridge, Oaklnds	1·68	43	72	*Derby*	Mickleover, Clyde Ho..	·89	23	50
,, .	Portsmouth, Vic. Park.	1·43	36	72	,, .	Buxton, Devon. Hos...	1·40	36	34
,, .	Ovington Rectory	1·49	38	58	*Ches.*	Runcorn, Weston Pt...	·97	25	48
,, .	Grayshott	1·79	45	70	,, ..	Nantwich, Dorfold Hall	1·13	29	...
Berks	Wellington College...	·91	23	46	*Lancs*	Bolton, Queen's Park .	1·98	50	...
,, .	Newbury, Greenham..	1·12	28	49	,, ..	Stonyhurst College....	1·65	42	45
Herts.	Bennington House....	...	...	...	,, ..	Southport, Hesketh...	1·15	29	52
Bucks	High Wycombe	1·86	47	95	,, ..	Lancaster, Strathspey.	1·48	38	...
Oxf..	Oxford, Mag. College..	·87	22	57	*Yorks*	Sedbergh, Akay	2·49	63	55
Nor .	Pitsford, Sedgebrook..	·90	23	51	,, .	Wath-upon-Dearne ...	·93	24	53
,, .	Eye, Northolm.....	·59	15	...	,, .	Bradford, Lister Pk...	1·50	38	62
Beds.	Woburn, Crawley Mill.	.69	17	39	,, .	Oughtershaw Hall	2·03	52	...
Cam.	Cambridge, Bot. Gdns.	·63	16	43	,, .	Wetherby, Ribston H..	1·58	40	81
Essex	Chelmsford, CountyLab	·73	19	...	,, .	Hull, Pearson Park ...	·98	25	54
,, .	Lexden, Hill House...	·75	19	...	,, .	Holme-on-Spalding ...	1·19	30	...
Suff .	Hawkedon Rectory ...	·51	13	27	,, .	Lowthorpe, The Elms.	1·24	31	62
,, .	Haughley House.....	·46	12	...	,, .	West Witton, Ivy Ho..	1·75	45	...
Norf.	Beccles, Geldeston....	·63	16	37	,, .	Pickering, Hungate ...	·89	23	...
,, .	Norwich, Eaton	·68	17	36	,, .	Middlesbrough	1·01	26	64
,, .	Blakeney	·64	16	39	,, .	Baldersdale, Hury Res.	1·31	33	43
,, .	Swaffham	·81	21	45	*Durh.*	Ushaw College	1·03	26	47
Wilts.	Devizes, Highclere....	1·13	29	54	*Nor .*	Newcastle, Town Moor.	·96	24	45
Dor .	Evershot, Melbury Ho.	2·01	51	67	,, .	Bellingham Manor....	1·03	26	...
,, .	Weymouth, Westham..	1·51	38	73	,, .	Lilburn Tower Gdns...	·29	7	...
,, .	Shaftesbury, Abbey Ho.	1·12	28	48	*Cumb*	Penrith, Newton Rigg..	...	...	...
Devon	Plymouth, The Hoe...	1·96	50	68	,, .	Carlisle, Scaleby Hall .	1·13	29	46
,, .	Polapit Tamar	2·59	66	87	,, .	Seathwaite	2·30	58	21
,, .	Ashburton, Druid Ho..	3·28	83	74	*Glam.*	Cardiff, Ely P. Stn.....	1·91	49	60
,, .	Cullompton	2·06	53	75	,, .	Treherbert, Tynywaun	4·12	105	...
,, .	Sidmouth, Sidmount ..	1·20	30	49	*Carm*	Carmarthen Friary....	2·46	63	65
,, .	Filleigh, Castle Hill ...	1·72	44	...	,, .	Llanwrda, Dolaucothy.	2·61	66	56
,, .	Hartland Abbey.....	1·59	40	...	*Pemb*	Haverfordwest, Portf'd	...	...	...
Corn.	Redruth, Trewirgie ...	2·45	62	68	*Card.*	Gogerddan.....	2·61	66	75
,, .	Penzance, Morrab Gdn.	1·92	49	60	,, .	Cardigan, County Sch. .	1·61	41	...
,, .	St. Austell, Trevarna..	2·81	71	82	*Brec .*	Crickhowell, Talymaes	2·25	57	...
Soms	Chewton Mendip	1·89	48	53	*Rad .*	Birm. W. W. Tyrmynydd	2·31	59	43
,, .	Street, Hind Hayes ...	1·04	26	...	*Mont.*	Lake Vyrnwy	2·61	66	61
Glos..	Clifton College	1·67	43	66	*Denb.*	Llangynhafal	·69	17	...
,, .	Cirencester	1·59	40	67	*Mer .*	Dolgelly, Bryntirion..	3·07	78	62
Here.	Ross, County Obsy. ...	·88	22	43	*Carn.*	Llandudno	·99	25	46
,, .	Ledbury, Underdown.	1·37	35	72	,, .	Snowdon, L. Llydaw 9	5·35	136	...
Salop	Church Stretton.....	1·26	32	53	*Ang .*	Holyhead, Salt Island.	1·44	37	55
,, .	Shifnal, Hatton Grange	1·51	38	82	,, .	Lligwy	1·61	41	...
Staff.	Tean, The Heath Ho...	1·31	33	56	*Isle of Man*				
Worc.	Ombersley, Holt Lock.	1·18	30	69		Douglas, Boro, Cem...	2·85	73	96
,, .	Blockley, Upton Wold.	1·11	28	52	*Guernsey*				
War.	Farnborough.....	1·35	34	64		St. Peter Port Grange .	2·85	73	115

Rainfall: March, 1924: Scotland and Ireland.

CO.	STATION.	In.	mm.	Per-cent. of Av.	CO.	STATION.	In.	mm.	Per-cent of Av.
Wigt.	Stoneykirk, Ardwell Ho	2·15	55	83	*Suth.*	Melvich School.....	2·40	61	84
,, .	Pt. William, Monreith .	1·86	47	...	*Caith*	Loch More, Achfary...	3·11	79	48
Kirk.	Carsphairn, Shiel.	1·66	42	...	,, ..	Wick	1·57	40	69
,, .	Dumfries, Cargen.....	1·51	38	42	*Ork .*	Pomona, Deerness	1·56	39	55
Dum	Drumlanrig	1·40	36	38	*Shet .*	Lerwick	3·22	82	103
Roxb	Branxholme	1·05	27	36	*Cork.*	Caheragh Rectory	2·30	58	...
Selk .	Ettrick Manse.....	1·06	27	...	,, ..	Dunmanway Rectory.	1·93	49	39
Berk.	Marchmont House	·90	23	34	,, ..	Ballinacurra	1·30	33	46
Hadd	North Berwick Res....	·66	17	35	,, ..	Glanmire, Lota Lo. ...	1·56	40	50
Midl	Edinburgh, Roy. Obs..	1·00	25	56	*Kerry*	Valencia Obsy.	1·57	40	35
Lan .	Biggar	·57	15	23	,, .	Gearahameen	3·60	91	...
Ayr .	Kilmarnock, Agric. C..	·78	20	28	,, .	Killarney Asylum.....	1·78	45	38
,, .	Girvan, Pinmore.....	·96	24	25	,, .	Darrynane Abbey	1·19	30	29
Renf.	Glasgow, Queen's Pk..	·60	15	23	*Wat .*	Waterford, Brook Lo..	1·40	36	51
,, .	Greenock, Prospect H..	1·67	42	34	*Tip .*	Nenagh, Cas. Lough...	1·03	26	33
Bute.	Rothesay, Ardencraig.	1·16	29	32	,, .	Tipperary	·72	18	...
,, .	Dougarie Lodge	·71	18	...	,, .	Cashel, Ballinamona ..	·84	21	31
Arg .	Glen Etive.....	·48	12	...	*Lim .*	Foynes, Coolnanes	1·53	39	52
,, .	Oban	·55	14	...	,, .	Castleconnell Rec.	·99	25	...
,, .	Poltalloch	·72	18	19	*Clare*	Inagh, Mount Callan ..	2·83	72	...
,, .	Inveraray Castle.....	·53	13	8	,, .	Broadford, Hurdlest'n.	1·27	32	...
,, .	Islay, Eallabus.....	·59	15	15	*Wexf*	Newtownbarry	1·11	28	...
,, .	Mull, Benmore	·80	20	...	,, .	Gorey, Courtown Ho...	·96	24	42
Kinr.	Loch Leven Sluice	1·04	26	35	*Kilk.*	Kilkenny Castle	·78	20	34
Perth	Loch Dhu	1·20	31	18	*Wic .*	Rathnew, Clonmannon	1·07	27	...
,, ..	Balquhidder, Stronvar.	·60	15	10	*Cars.*	Hacketstown Rectory .	·97	25	35
,, ..	Crieff, Strathearn Hyd.	·91	23	28	*QCo..*	Blandsfort House.....	·84	21	32
,, ..	Blair Castle Gardens ..	·56	14	...	,,	Mountmellick	·77	20	...
,, .	Coupar Angus School..	·65	17	30	*KCo.*	Birr Castle.....	·78	20	32
Forf.	Dundee, E. Necropolis.	·78	20	38	*Dubl.*	Dublin, FitzWm. Sq...	·49	12	25
,, .	Pearsie House.....	·80	20	...	,, .	Balbriggan, Ardgillan .	1·49	38	74
,, .	Montrose, Sunnyside..	·63	16	30	*Me'th*	Drogheda, Mornington	1·38	35	...
Aber.	Braemar Bank	·81	21	28	*W.M*	Mullingar, Belvedere .	1·24	31	46
,, .	Logie Coldstone Sch. ..	1·22	31	47	*Long*	Castle Forbes Gdns....	1·86	47	63
,, .	Aberdeen, Cranford Ho	1·38	35	53	*Gal .*	Galway, Waterdale ...	1·76	45	...
,, .	Fyvie Castle	3·21	81	...	*Mayo*	Crossmolina, Enniscoe	...	...	...
Mor .	Gordon Castle.....	1·31	33	56	,, .	Mallaranny.....	2·18	55	...
,,	Grantown-on-Spey....	...	...	...	,, .	Westport House.....	1·85	47	47
Na .	Nairn, Delnies.....	·71	18	38	,, .	Delphi Lodge	3·04	77	...
Inv..	Ben Alder Lodge	·74	19	...	*Sligo*	Markree Obsy.	1·54	39	45
,, .	Kingussie, The Birches	·52	13	...	*Ferm*	Enniskillen, Portora ..	·68	17	...
,, .	Fort Augustus	·40	10	11	*Arm.*	Armagh Obsy.	1·16	29	49
,, .	Loch Quoich, Loan....	2·00	51	...	*Down*	Warrenpoint	1·08	27	...
,, .	Glenquoich	1·00	25	10	,, .	Seaforde	1·85	47	63
,, .	Inverness, Culduthel R.	·87	22	...	,, .	Donaghadee	1·48	38	68
,, .	Arisaig, Faire-na-Squir	...	...	...	,, .	Banbridge, Milltown .	1·99	25	45
,, .	Fort William.....	·53	13	8	*Antr.*	Belfast, Cavehill Rd. ..	2·00	51	...
,, .	Skye, Dunvegan.....	2·41	61	...	,, .	Glenarm Castle.....	1·91	49	...
,, .	Barra, Castlebay	·87	22	...	,, .	Ballymena, Harryville	1·09	28	35
R&C	Alness, Ardross Cas. ..	1·86	47	57	*Lon .*	Londonderry, Creggan	·55	14	17
,, .	Ullapool.....	2·96	75	...	*Tyr .*	Donaghmore	1·19	30	...
,, .	Torridon, Bendamph..	1·74	44	23	,, .	Omagh, Edenfel	·93	24	30
,, .	L. Carron, Plockton...	·76	19	...	*Don .*	Malin Head	·51	13	22
,, .	Stornoway	4·41	112	108	,, .	Rathmullen.....	...	...	...
Suth.	Dunrobin Castle.....	...	...	...	,, .	Dunfanaghy	·86	22	24
,, .	Lairg	1·75	44	...	,, .	Narin, Kiltoorish	·60	15	...
,, .	Tongue Manse.....	2·37	60	71	,, .	Killybegs, Rockmount.	1·75	44	34

Foynes, February 1·68 ins., 43 mm., 53 %

Climatological Table for the British Empire, October, 1923

STATIONS	PRESSURE		TEMPERATURE							Relative Humidity	Mean Cloud Am'nt	PRECIPITATION			BRIGHT SUNSHINE	
			Absolute		Mean Values				Mean							
	Mean of Day M.S.L.	Diff. from Normal	Max.	Min.	Max.	Min.	½ max. and min.	Diff. from Normal	Wet Bulb.			Am'nt	Diff. from Normal	Days	Hours per day	Percentage of possible.
	mb.	mb.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	%	0—10	mm.	mm.			
London, Kew Obsy.	1007·5	— 6·5	65	33	56·8	45·3	51·1	+ 1·2	48·8	83	7·1	135	+ 66	24	3·0	2·8
Gibraltar	1017·4	+ 2·2	82	51	73·8	62·0	67·9	+ 1·8	62·6	76	4·7	44	— 40	5	...	...
Malta	1019·0	+ 3·3	81	62	75·9	66·6	71·3	+ 1·5	64·7	73	2·4	2	— 66	2	...	...
Sierra Leone	1011·9	— 0·1	90	70	86·7	72·5	79·6	— 0·6	75·5	77	5·9	300	— 21	27	...	...
Lagos, Nigeria	1011·4	— 0·3	89	71	85·7	74·1	79·9	+ 0·8	76·1	78	7·8	136	— 60	19	...	...
Kaduna, Nigeria	1014·6	+ 2·3	96	...	87·3	...	...	...	72·2	76	2·4	71	+ 11	9	...	...
Zomba, Nyasaland	1010·8	+ 0·3	93	54	85·5	64·5	75·0	+ 0·9	...	81	4·0	12	— 26	4	...	...
Salisbury, Rhodesia	1010·9	— 0·1	97	42	88·8	53·5	71·1	+ 0·3	59·6	43	1·0	5	— 25	1	...	...
Cape Town	1016·4	— 1·0	89	49	71·4	55·0	63·2	+ 2·2	59·9	71	4·9	19	— 25	6	...	...
Johannesburg	1013·7	+ 1·6	88	35	79·5	55·3	67·4	+ 4·8	52·6	43	3·0	21	— 40	2	9·7	76
Mauritius	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Bloemfontein	...	...	96	40	84·4	55·7	70·1	+ 5·5	54·9	41	4·0	20	— 23	5	...	...
Calcutta, Alipore Obsy.	1010·5	+ 1·1	91	68	87·6	73·6	80·6	— 0·1	74·3	83	4·7	135	+ 36	5*	...	...
Bombay	1010·5	+ 0·8	93	74	89·3	77·1	83·2	+ 0·9	75·5	81	3·9	0	— 47	0*	...	...
Madras	1009·5	+ 0·6	98	71	90·0	75·2	82·6	+ 0·5	76·7	80	6·0	404	+118	13*	...	...
Colombo, Ceylon	1010·3	+ 0·5	89	68	86·0	74·2	80·1	— 0·4	77·2	72	7·8	338	— 19	26	7·2	60
Hong Kong	1013·7	+ 0·1	87	67	80·2	72·5	76·3	— 0·6	69·4	72	5·6	453	+328	8	6·9	59
Sandakan	...	...	90	74	87·8	75·3	81·5	0·0	77·1†	76†	...	122	—132	14	...	...
Sydney	1013·8	— 1·1	95	49	71·7	55·3	63·5	0·0	56·3	62	4·0	37	— 38	8	7·9	61
Melbourne	1013·1	— 1·6	84	41	65·7	49·0	57·3	— 0·3	52·8	65	7·0	93	+ 27	16	5·3	41
Adelaide	1015·6	— 0·5	90	44	69·3	52·1	60·7	— 1·2	53·1	58	6·0	56	+ 12	14	6·1	47
Perth, W. Australia	1018·1	+ 1·2	81	45	67·8	51·6	59·7	— 1·2	54·5	70	5·1	63	+ 9	14	6·6	52
Coolgardie	1015·2	0·0	95	41	78·6	50·5	64·5	+ 0·9	54·4	35	4·1	0	— 19	0	...	...
Brisbane	1015·6	— 0·5	94	51	80·8	61·2	71·0	+ 1·1	63·1	54	3·5	11	— 56	4	9·3	74
Hobart, Tasmania	1009·3	— 1·3	82	37	60·8	46·0	53·4	— 0·6	48·8	68	7·3	91	+ 34	22	5·8	44
Wellington, N.Z.	1013·5	+ 1·2	67	38	61·1	48·8	54·9	+ 0·6	50·9	75	8·0	97	— 10	16	4·3	33
Suva, Fiji	1014·7	+ 1·5	84	57	79·6	66·4	73·0	— 3·0	70·3	75	6·6	240	+ 42	16	...	...
Kingston, Jamaica	1010·7	— 1·2	95	71	89·3	73·3	81·3	+ 0·8	...	74	6·9	201	+ 11	10	...	...
Grenada, W.I.	1012·0	+ 1·0	90	74	85·4	75·5	80·5	+ 0·4	75·9	76	5·3	89	— 97	16	...	...
Toronto	1020·0	+ 2·0	69	32	57·0	40·6	48·8	+ 1·9	42·4	77	4·5	42	— 20	7	5·6	50
Winnipeg	1019·3	+ 4·0	74	12	53·9	32·9	43·4	+ 2·6	38·2	83	4·3	13	— 25	5	5·3	49
St. John, N.B.	1017·6	+ 1·1	65	30	55·5	41·4	48·5	+ 3·2	45·0	85	5·5	85	— 30	12	5·1	46
Victoria, B.C.	1017·2	— 0·4	74	41	58·4	47·1	52·7	+ 2·3	49·1	88	5·2	44	— 21	11	5·2	48

* For Indian stations a rain day is a day on which 0·1 in. (2·5 mm.) or more rain has fallen. † Mean of observations at 9h., 15h., 21h., from April, 1923.

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A Great French Meteorologist

By SIR NAPIER SHAW, F.R.S.

CHARLES ALFRED ANGOT was Director of the Bureau Central Météorologique of France from 1907, when Mascart retired, until after the war. The meteorological and geophysical services of France were reconstituted in 1920 and the functions of the old bureau divided between an Office National for meteorology and an Institut Géophysique for magnetism and seismology. Angot retired with the title of "directeur honoraire." In his retirement he and his wife were cheered by a bevy of grandchildren, who were an unfailing source of pleasure.

He was born at Paris in 1848, joined the Bureau Central, under Mascart, in 1879, and was also Professor of Physics and Meteorology in the Institut Agronomique National. The Symons medal of the Royal Meteorological Society was awarded to him in 1916, and he was elected an honorary Fellow of the Royal Society of Edinburgh last year.

My first recollection of him, forty-five years ago, pictures him conducting an elaborate investigation into the interpretation of the readings of wet and dry bulb thermometers. I was engaged in the same kind of occupation at the time. He made a parabolic formula to allow for a wide range between wet and dry, and one of the things which I always meant to do and can never do is to ask him whether in his later experience he found the parabolic formula of any practical meteorological advantage.

I learned to know him personally at the Conference on Meteorology at the International Exhibition held at Paris in

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1900. Mascart was presiding in his own admirable way over a cosmopolitan assembly that in one form or other secreted most of the meteorological heresies known to history, and Angot was the urbane and efficient secretary, the interpreter of many maladroit expressions. He had a wonderful gift of catching the meaning of people who, for one reason or another, were unable to express themselves intelligibly, and of putting it in pellucid French. It was a gift which was subsequently placed unreservedly at the service of the International Meteorological Committee, to which he was elected at the close of the meeting, held in Paris in 1907. At the same meeting it became my duty, for the first time, to take the chair at the Committee, and from that time, at many meetings in many countries, he has always been an admirable colleague and an ever-welcome friend. He had English relatives and spoke English fluently.

His scientific education was rigorous and profound, his industry unfailing, and his contributions to meteorology and terrestrial magnetism numerous and effective, as the Annales of his bureau bear witness. His discussion of the diurnal variation of the barometer was at one time the most frequently consulted contribution to meteorological literature in the Meteorological Office, and, since then, besides the official reports which are very elaborate, especially as regards thunderstorms, he has presented memoirs on the Climate of France, the observations on the Eiffel Tower, and Magnetic Charts of France. He was also the author of an excellent Treatise on Meteorology.

The Bureau suffered, as our own Office did, from the towering majesty of the sciences of Astronomy, Physics and Mathematics by which it was surrounded and in part controlled. On both sides of the Channel we were waiting for the genius of a Newton or a Laplace to endow us with a formula. In France, as with us, the daily response to the public demand for forecasts and storm-warnings left the officials with very little of that audacity upon which science like most other enterprises depends. The opportunity for initiative in both countries was left for private enterprise; the official contributions, safe and solid if not exciting, were rather of the nature of concrete foundations undeniably necessary for the ultimate structure, contributions which excite the admiration of the few who know, rather than of the many who think that the daily forecasts represent the whole duty of every meteorologist.

Until September last Angot was President of the International Commissions for Agricultural Meteorology and for Terrestrial Magnetism and Atmospheric Electricity. His retirement from those duties because he was unable to attend the Conference at Utrecht is too speedily followed by his death, which took place at his home in Paris on March 16th.

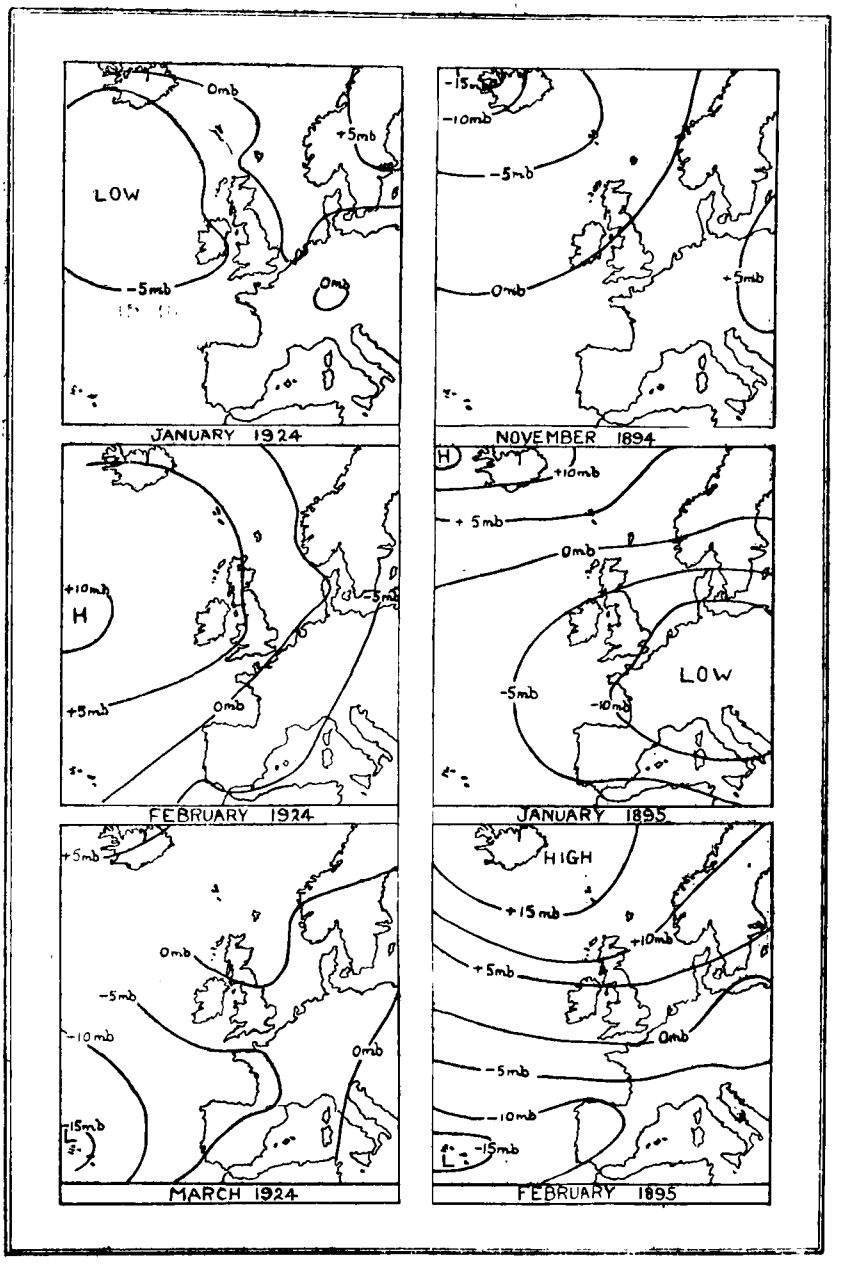
The Abnormal Weather of the Winter and Early Spring, 1923-4

By C. E. P. BROOKS, M.Sc.

THE chief characteristic of the weather during November and December, 1923, and again during February and March, 1924, was the abnormal frequency of northerly and easterly winds. During the first two months there were considerable falls of sleet and snow in different parts of Great Britain, but the average precipitation over the whole country failed to reach the normal; February and March were distinctly dry. All four months had a mean temperature below normal. In sharp contrast to these two periods of rather cold dry weather, January 1924 was mild, unsettled and rather rainy.

The sequence of events can be studied from the monthly charts of mean deviation of pressure from the normal, which are now regularly drawn for western Europe, the North Atlantic and North America. October 1923 was a wet stormy month; pressure was more than 15 mb. below normal north of Scotland, the deficit reaching 18 mb. over the Faeroes; a large number of depressions passed in an east-north-east direction between Iceland and the British Isles. Over the greater part of North America pressure was above normal, the excess exceeding 5 mb. west of the Great Lakes. By November, the deficit of pressure had shifted from north of Scotland to the Baltic, where pressure was 10 mb. below normal, and the North Atlantic was occupied by a great area in which pressure was above normal, the excess being 5·6 mb. at Horta and 11·5 mb. at the point 50° N 30° W. Over the British Isles the isanomalies of pressure (lines of equal deviation of pressure from normal) were directed from north to south; northerly winds were abnormally frequent, and the tracks of depressions, although irregular, lay on the whole from north-west to south-east. In December, conditions were somewhat similar, but the area of maximum pressure-deficit had shifted northward and the pressure-excess had moved south-eastward, and was centred between the Azores and Corunna. The monthly maps for January, February and March, 1924, are shown on the left hand half of p. 80. Attention is directed to the map for March, which shows a deficit of pressure exceeding 15 mb. at the Azores. Actually pressure was 15·5 mb. below normal at Horta, and 6·7 mb. above normal at Stykkisholm in Iceland. Since the average pressure difference between these two stations in March is only 12·5 mb., it follows that the normal pressure gradient was completely reversed, and cold easterly winds prevailed over the British Isles.

Since the beginning of observations in 1865 there have been



PRESSURE ANOMALIES IN TWO WINTERS

only two other months in which the mean pressure at the Azores was more than 15 mb. below normal, namely February 1895. and February 1912. The whole winter of 1894 to 1895 was rather similar to that of 1923 to 1924 (see the right hand side of p. 80.) November 1894 was a month of strong southerly and south-westerly winds, and may be compared with January 1924. December 1894 and January 1895 had a similar pressure distribution (only the latter month is illustrated), which resembled that of February 1924 in being favourable to north-easterly winds. February 1895 showed an extraordinary pressure gradient from north to south, resulting in abnormally strong cold, easterly winds and a rainfall much below normal. It will be remembered that skating was general in the east and south of England during this month. It is interesting to note that in 1895 pressure remained high over Iceland and low over the Azores until June, giving the spring drought of that year.*

The conditions both preceding and following February 1912 differed considerably from those preceding and following February 1895. March 1912 was very wet and stormy and, although April was extremely dry, the general conditions during the summer were rainy, so that it is not safe to conclude that we are on the verge of another drought.

The general westerly winds between the Azores and Iceland are accepted as one of the prime facts of the meteorology of the globe, and, if for a whole month they are completely reversed, we are faced with a noteworthy disturbance of the normal circulation, which argues a correspondingly effective cause.

There is another notable abnormality in the weather of the past winter which may have some bearing on the problem, namely the remarkably high air temperature at Spitsbergen. The difference from normal was + 9° F. in October, + 14° F. in November, + 12° F. in December, + 15° F. in January, and + 20° F. in February. The long duration of this high temperature suggests that the layer of warm air was both extensive and deep. The ice conditions in the Arctic Ocean point to unusually high sea temperatures. In the summer and autumn of 1923 the Arctic Ocean was remarkably free from ice ; in the Barents Sea the area ice-covered during August was the least recorded since the beginning of observations in 1895, and in the Kara Sea there was very much less than the normal amount, while during September and October both these seas were practically free of ice. No information is available for the Arctic Ocean after October, but at the end of November the White Sea was still open, which is unusual. The normal gradient for westerly winds

* *Vide* The drought of 1921. *London Q. J. R. Meteor. Soc.*, Vol. xlviii., 1922, p. 139.

in temperate latitudes is attributed to the temperature gradient between the polar regions and the equator, and F. M. Exner * obtained good negative correlation between the temperature at various places in the Arctic and the pressure at Ponta Delgada, so that the mass of warm air in the Arctic Ocean during the past winter may have had a notable effect on the presssure distribution in the North Atlantic.

It is to be remarked that in March the temperature abnormality at Spitsbergen suddenly disappeared. This is perhaps to be attributed to the prolonged north-easterly winds having retarded or reversed the drift of the warm surface waters of the North Atlantic towards the Arctic Ocean. If so, it indicates that the normal westerly circulation is to be restored, or even that the pendulum will swing the other way. These normal conditions in the Arctic will tend to give us normal conditions in the British Isles, but, as the abnormal winds must have disturbed the distribution of temperature throughout the whole of the North Atlantic Ocean, there is no reason to assume that there will not be more spells of anomalous weather. As in most other meteorological phenomena, there are, however, processes at work which automatically bring about a swing of the pendulum, and maintain the balance of our climate from year to year.

Royal Meteorological Society

THE monthly meeting of the Society was held on Wednesday, April 9th, at 49, Cromwell Road, South Kensington, Dr. C. Chree, F.R.S., Vice-President, in the Chair.

I. D. Margary, M.A.—Glaisher Stand versus Stevenson Screen. A comparison of 40 years' observations of maximum and minimum temperature as recorded in both screens at Camden Square, London.

As long as Camden Square was the home of the British Rainfall Organisation the observations of temperature utilised in all published reports were the readings of thermometers exposed on a Glaisher stand. The Glaisher stand is essentially a vertical board mounted in such a way that it can easily be turned by hand so as to keep its back to the sun. It has long been recognised that such an arrangement has two defects. It can only be used where it can be visited two or more times each day and, moreover, the thermometers, though shielded from direct radiation from the sun, are exposed to radiation from the ground and from other bodies in the neighbourhood, so that a true

* Über monatliche Witterungsanomalien auf der nördlichen Erdhälfte im Winter. Wien, *Sitz Ber. Ak. Wiss.*, 122, 1913, p. 1165.

record of air temperature can not be obtained. For comparative purposes a Stevenson screen was set up by Symons near the Glaisher stand, and readings of the two sets of thermometers were taken regularly. When the Royal Meteorological Society took over the climatological station a new Stevenson screen was installed, and the question arose whether the averages which had been worked up for the Glaisher stand observations could be adjusted to serve as a standard of comparison for the new readings. The Society is greatly indebted to Mr. Margary for undertaking the reduction of the accumulated observations. His investigation brings out the desirability of a close control of the observations when small differences in thermometer readings have to be investigated.

Mr. Margary's work shows that on the average the maximum thermometer on the Glaisher stand read 1·3° F. higher than that in the Stevenson screen in July, but it read ·5° F. lower in December. There are indications, however, that these differences are to be attributed in part to errors in the thermometers. We are inclined to differ from Mr. Margary and to take the view that if the thermometer errors could have been eliminated the differences would have been in the same sense at all seasons, the Glaisher readings being the higher by nearly 2° F. in summer and by a small fraction of a degree in winter. As to the minimum thermometer readings, the lower temperatures are always recorded on the open stand, as was to be expected on general principles. Mr. Margary investigated the effect of winds from different directions and found that with northerly winds the temperatures recorded on the Glaisher stand were lowered: the explanation in the case of the maximum readings is that in the daytime the stand is set to face north, and a north wind blows straight on to the thermometers, and a close approximation to the air temperature is obtained: perhaps a similar explanation holds good in the case of the minimum temperatures; at night the stand is turned so that the thermometers are more or less sheltered from the north wind and the effects of radiation are accentuated.

It will be interesting to see how well Mr. Margary's conclusions are supported by the investigation which is now being carried out at Kew Observatory, where a large number of different thermometer exposures are being compared.

Robin Hill.—A Lens for whole sky Photography.

Readers of the *Meteorological Magazine* will remember the beautiful photographs which were reproduced in the November, 1923, number in connection with the account of the International Cloud Week. Mr. Robin Hill exhibited the camera with which these photographs were taken, and showed with the lantern many

other examples of his work. The only drawback to his method of photography, the reproduction of the whole sky on a single plate, is that distortion is inevitable. He showed, however, how his negatives could be used to produce undistorted pictures of parts of the sky. An interesting application of the method is the production of stereoscopic pictures from which a general idea of the relative heights of the clouds can be obtained. One of the most striking of Mr. Hill's photographs showed a halo and a complete mock sun-ring.

F. J. W. Whipple, M.A., F.Inst.P.—The significance of regression equations in the analysis of upper air observations.

This paper is devoted to a criticism of the assumption that a regression equation can show which of two contemporary phenomena is cause and which effect. We will not attempt to summarise the argument.

Correspondence

To the Editor, *The Meteorological Magazine*

Weather Lore in the Light of Science

ALLOW me to thank you for the kind Review of my little book "Weather Proverbs and Paradoxes" in your January number.

You are quite right in the statement that the numerical values of the probabilities are not given. My chief purpose was to find, so far as I could, the underlying cause or causes of the phenomena in question, and to show the logical positions of these phenomena in the usual sequence of weather conditions. The numerical value of the probable correctness of each proverb doubtless varies from place to place.

The forecasting value of halos, for instance, can be worked up, as you say, without much labour, and has been worked up for several places: see, for instance the *Monthly Weather Review*.* I felt, perhaps mistakenly, that statistics would better be omitted from a book of the kind I was trying to write. Statistics in such a book would seem to me (of course this is just my personal feeling on the subject) much like salt, a mighty tasty condiment, in one's tea or coffee—a good thing, but out of place.

The addition of the expression "and lowering" in connection with the red of the morning sky may be all important. However, in the original Greek, there is no "and." The literal translation, as I have it from a Hellenist, is "reddens lowering." Hence, perhaps, the red itself may, in the morning, constitute the lower-

* Washington, *Monthly Weather Review*, Vol. 42, pp. 446-451; Vol. 43, pp. 444-445; Vol. 44, pp. 67-68; Vol. 46, pp. 119-120 and p. 552.

ing element, based on past experiences of rains. Scattered clouds alone would not, presumably, be called lowering, and a fully overcast sky could not be red. Furthermore, it is quite possible, I am told, that the word translated lowering was put in the original for a stylistic purpose. Certainly, as translated, it, or some other expression, is essential to a graceful termination.

For all these reasons I assumed that whether the sky were clear or partially cloudy, red was the essential feature. In any case, the whole subject of the red sky is not particularly simple and elementary. Perhaps, after all, we should recognize, as did FitzRoy, two kinds of red. We might do this for both morning and evening. A rose-red, clear sky indicating fair weather in the evening, and probably also in the morning; a bull's-blood-red sky, with many clouds, indicating foul weather both morning and evening.

W. J. HUMPHREYS.

Weather Bureau, Washington, February 18th, 1924.

Steaming Roads

CONSIDERABLE surprise was caused in this town this afternoon by a thick mist rising from the ground. At 2h. 15m. or so, there was a hailstorm lasting a considerable time. Before stopping altogether it turned to rain. I was in an upstairs room looking down on an asphalted road and, before the rain stopped, I noticed something blowing up the road: I could not make out whether it was smoke from a brazier out of sight, smoke blown down from a chimney or the shadow of smoke or clouds (as the window faces eastwards I could not see if clouds were blowing across the sun).

About 3 o'clock I was visiting on the side of Stinchcomb Hill, and my attention was drawn to the way the ground in a garden was smoking. I was not convinced at first that it was not thick smoke from a bonfire out of sight, but soon found that the whole hill (except the road where I was standing, which was shadowed or at any rate a great part of it) was "smoking." The "smoke" was white and opaque and did not rise more than a yard or so from the ground. It had ceased, I think, by about 3h. 45m.

LANCELOT ANDREWS.

Dursley, Gloucester, April 10th, 1924.

[Somewhat similar observations were reported in the *Meteorological Magazine* in the issues for July and August, 1922. Such a long spell of steaming as 45 minutes is surely very exceptional. —ED. *M.M.*]

The Propagation of Sound in the Atmosphere

MR. WHIPPLE'S article in the April number of this magazine interested me as it may afford an explanation of the following facts. During 1916 and 1917 the guns on the western front were clearly audible here from April to October but never during the winter months. There is one spot on this hill where on a calm morning I could actually distinguish the sounds of different kinds of guns, and even in bad weather the throbbing was always audible—but never in winter. The distance cannot be less than 150 miles, and it seemed incredible that guns which could not be heard twenty miles behind the line should be so clearly audible here. The earliest date for hearing them was April 8th and the latest about October 15th. Can the differences in mean temperature account for the absence of sound in the winter, during which there are so many warm days?

J. M. ROGERS, Lt.-Col.

Riverhill, Sevenoaks, April 26th, 1924.

[Seasonal variation in the audibility of distant explosions has not yet been explained. The matter was discussed in papers read before the Royal Meteorological Society in 1918 and 1919.—ED. *M.M.*]

Low Velocities in the Upper Air

IN the note on "Pilot Balloon Observations at Barcelona," which appeared in the *Meteorological Magazine* for March, p. 36, records of dead calms reaching to 900 metres and 600 metres are given. There are no records of dead calms reaching to such heights in Egypt, but there are several occasions when the wind has been very light for considerable heights. As an example, on May 1st, 1922, at Helwan, near Cairo, the wind at the surface was 14 kilometres per hour from NE. At 500 metres it had fallen to 8 k.p.h., and from this height up to 6,000 metres (where the velocity was only 2 k.p.h.) it did not at any point exceed 10 k.p.h. There were two reversals of direction, from NE to SW at 500 metres, and from SE to NW at 5,000 metres, while between 2,500 metres and 3,500 metres the wind veered from SW to SE. The observations were made every minute with two theodolites. On September 5th, 1921, a velocity of 10 k.p.h. was not exceeded up to a height of 3,000 metres, and on February 1st, 1922, this velocity was not exceeded below 5,000 metres, although the westerly anti-trades were entered at 3,500 metres.

L. J. SUTTON.

Physical Department, Cairo, April 7th, 1924.

NOTES AND QUERIES

Earwigs and Recording Instruments

IN the *Meteorological Magazine* for September and November, 1922, correspondents drew attention to the trouble experienced by observers in keeping earwigs out of recording instruments, such as automatic rain-gauges. At certain times of the year and especially in the autumn, earwigs, in great numbers, have been known to find their way into the automatic rain-gauge, stop the channels and clog the moving parts. A form of shield designed in the Instruments Division of the Meteorological Office, at the suggestion of the Natural History Museum, has proved to be an effective barrier against insects.

The shield, which is conical in shape, has a diameter of two feet at the top and of one foot at the bottom and is six inches deep. The outside surface is rather smooth and is inclined at an angle of 45° to the horizontal. The lower edge of the shield is to be forced about two inches into the turf round the gauge. Whether earwigs undertake the climb and then fail to negotiate the sharp edge at the top or whether they turn their backs on the obstacle altogether has not been reported. The essential fact is that they do not get into the rain-gauge.

The present price of the shield is 5s. 6d., excluding the cost of packing-case and carriage.

The Green Auroral Line in the Laboratory

AN account of Professor Vegard's experiments in which he produced light by the bombardment of solid nitrogen with cathode rays has been published in the Proceedings of the "Koninklijke Akademie van Wetenschappen te Amsterdam" (Vol. 27, p. 113). The solid nitrogen was a deposit on the end of a copper rod, the other end of which was bathed in liquid hydrogen. The identity of the lines of the resulting spectrum with the principal lines of the aurora is completely established. It appears that the relative strength of the lines depends on the speed of the electrons in the cathode rays. The luminosity of the solid nitrogen is apparently akin to phosphorescence, as it persists for five minutes after the cathode ray bombardment ceases: this characteristic recalls the green afterglow which is observed for five or ten minutes after the production of auroral rays has stopped. Vegard's experiments open up new lines of investigation both in meteorology and in pure physics. Of course it is not yet established that particles of solid nitrogen exist in the upper atmosphere; the light produced in the laboratory might come from ionized monatomic gas emanating from

the solid under the influence of the cathode rays. There is no meteorological difficulty in the assumption that monatomic nitrogen would float in the high atmosphere.

Rainfall Insurance

THERE are few enterprises more likely to be affected by bad weather than the collection of money in the streets for charitable purposes. The promoters of the "Flag-day" on April 30th, 1924, in aid of the "Combined Docklands Settlements," guarded themselves against the dead loss of the expenses of organisation by taking out a policy of insurance against rain occurring between 9 a.m. and 4 p.m. on that day. As it fell out, there was persistent rain, and the amount measured in St. James's Park, ·51 in., was well above the amount of ·1 in. specified in the policy. It is understood that the policy was for £1,500. Of course, this amount is not compensation for the comparative disappointment as to receipts; it merely puts the promoters in a position to cover the expenses for which there was no direct return—a very valuable example of indemnification.

Apia Observatory, Samoa

THE Government of New Zealand is responsible to the League of Nations for the Mandated Territory of Western Samoa. The third annual report recently communicated to the League contains an account of the meteorological work which is being done at the Apia Observatory. A brief account of the history of this Observatory, and the circumstances under which it was being carried on by New Zealand, with the aid of a grant from the British Government, was given in the *Meteorological Magazine* for 1921, pp. 100 and 225.

We now learn that the Observatory is undertaking extensive work in connection with marine meteorology. Weather reports are broadcasted twice daily, and more frequently during the transit of a cyclone. Moreover, in the case of the cyclone of March, 1923, it was found practicable to give the position of the storm centre and the direction of its path. Between June and December, 1923, eighty pilot balloon flights were made, the highest recorded flight being 21,000 metres. The Apia Observatory has been made the station for the receiving, analysing and publishing of the weather data from Suva (Fiji) and Nukualofa (Tonga), Norfolk Island, Vila (New Hebrides), Tutuila (American Samoa), Papeete (Society Islands), and Noumea (New Caledonia). This initiation of a weather service for the western Pacific is to be welcomed.

The document contains a brief summary of the meteorological observations made during 1922, but full reports are being printed separately.

Radiation from the Sky

RADIATION MEASURED AT BENSON, OXON, 1924.

Unit: one gramme calorie per square centimetre per day.

ATMOSPHERIC RADIATION only (dark heat rays).

Averages for Readings about time of Sunset.

		Jan.	Feb.	Mar.
Cloudless days:				
Number of readings	n	8	4	7
Radiation from sky in zenith ...	πI	446	416	464
Total radiation from sky ...	J	473	440	497
Total radiation from horizontal black surface on earth ...	X	633	638	673
Net radiation from earth ...	X—J	160	198	176

DIFFUSE SOLAR RADIATION (luminous rays).

Averages for Readings between 9 h. and 15 h. G.M.T.

Cloudless days:—				
Number of readings	n_0	4	2	1
Radiation from sky in zenith ...	πI_0	16	15	27
Total radiation from sky ...	J_0	20	23	23
Cloudy days:—				
Number of readings	n_1	5	4	0
Radiation from sky in zenith ...	πI_1	26	31	—
Total radiation from sky ...	J_1	25	25	—

Unit for I = gramme calorie per day per steradian per square centimetre.
Unit for J and X = gramme calorie per day per square centimetre.
For description of instrument and methods of observation, see *The Meteorological Magazine*, October, 1920, and May, 1921.

A "Maximum" Anemometer

A SIMPLE anemometer for indicating the maximum strength of the wind is described by Dr. P. L. Mercanton, of Lausanne, in *La Nature*, February 23rd, 1924. A Pitot tube is mounted on a vane. The tube, which contains liquid paraffin, has two arms, one connected to an opening which faces up wind, the other to an opening in the wall of a little channel parallel to the wind. In the latter arm, which is not very steep, there are little pockets. The stronger the wind, the higher the liquid reaches up this arm and the larger the number of pockets that are filled. The anemometer is calibrated by comparison with an ordinary pressure gauge.

The Jamaica Weather Service

A USEFUL summary of the observations taken in the West Indies has recently been published by Mr. J. F. Brennan, the Government Meteorologist.

The Jamaica Weather Service was established in 1880, owing to the initiative of the late Maxwell Hall, and in 1881 the important station at Kingston commenced observations. The Service was disestablished in 1902, and although other stations continued in operation, and an annual grant of £50 was made for the publication of the Jamaica Weather Report, the station at Kingston was closed. This was partly owing to the establishment of a station at Halfway House by the U.S. Weather Bureau. In March 1902 the publication of the Report was transferred to the Office of the Island Chemist, and it was not till 1907 that the Weather Service was re-established. In July 1907 the Weather Bureau station at Halfway House was closed, but with the co-operation of the Weather Bureau the station at Kingston was reopened in 1908.

The new series of observations covers 15 years. The summaries now published extend over the 33 years for which fairly complete observations are available. May we regard this as the prelude to the establishment of a first-class meteorological observatory in Jamaica? It is hardly creditable to the meteorologists of the British Empire that there should be no station in the British West Indies with a reliable continuous record of pressure and other meteorological elements.

To determine the correction to be applied to barometer readings at assigned hours to obtain the daily means Mr. Brennan had to fall back on figures based on the records of a photographic barograph which was only in operation for 12 months about 30 years ago!

Birmingham and Midland Institute

THE meteorological observations at the Observatory at Edgbaston, Birmingham, were published *in extenso* from 1891 to 1897. Publication is now being resumed: the pamphlet containing the 1923 observations has been issued recently. The averages for the station for the past 36 years are given in a convenient form.

The instrumental equipment at the Observatory has recently been improved by the addition of a Dines anemograph. The vane is above the cups of the Robinson anemograph on the Observatory Tower, more than 100 feet above ground. The direction-recorder is of the Box and Cox pattern, in which there are two pens; one of which is at rest when the other is active.

Underground Water Level: Slow Recovery after Drought

MR. SPENCER RUSSELL'S report on observations of the level of the water in various wells indicates that in the North Downs the effects of the drought of 1921 are still felt. At the deep wells on the hills above Maidstone the water remained during 1923 far below the average level. At Little Pett Farm the mean level for 1923 was 27 ft. 7 ins. below average, at Hucking (Old Forge) 18 ft. 2 ins., and at Stockbury 8 ft. 11 ins. On the other hand at Chilgrove, Sussex, on the South Downs, there was no marked departure from the average level. Mr. Spencer Russell attributes the difference between the behaviour of the wells of the North and South Downs to the difference between the rates of percolation in the Middle Chalk of the North Downs and the Upper Chalk of the South Downs.

The Reverse of Daylight Saving

IT is announced that on May 1st clocks at Moscow were to be put back one hour, the standard of time being changed from 3 hours ahead of Greenwich to 2 hours ahead. Thus the standard time for Moscow (37° 36′E) is now practically the mean time of Leningrad (the former St. Petersburg), which is in longitude 30° 20′E. The effect of the change is to deprive the citizens of Moscow of an hour's daylight each evening.

A Florid Weather Diary, Worcestershire, 1703

THROUGH the courtesy of the Provost and Fellows of Lancing College, a weather diary for the year 1703, kept by J. Whiston, was recently lent to the Meteorological Office. We are indebted to Mr. Zealley for a true copy of the diary and for an introduction from which the following notes have been gathered.

A summary of the weather for each day of the year is given, usually occupying about six lines, and always accompanied by the wind direction for the day in question. This wind direction, observed from a wind vane, appears to have been the only regular instrumental observation. For most days a very elaborate description of the weather follows, together with discourses and theories on certain phenomena. Frequent mention is made of " Mr. Boyle " and of his experiments.

It was difficult at first to establish the exact place where Whiston's observations were taken. However, towards the end of the volume, there is an indication that the place was called Egioke. . . " I love Egioke as a Title and Residence to our ancesters " . . . Mr. Zealley consulted old maps of Worcestershire, dating from 1500 onwards, but Egioke was

not marked on any. However, on visiting the district he found that about two miles east-south-east of the village of Feckenham, in the county of Worcestershire, there was a small group of houses now known as Edgiock. No doubt this is the site where most of the observations were taken.

From an agricultural point of view the diary is of great interest, many references being made to the harvest, crops and farming. Phenological observations are also made, as for instance: "March 4th. . . 1st Butterfly I saw to-day morn flying in ye air. . ."

Most elaborate descriptions are given, as for example (under June 19th)—

> . . . "Evening lovely fresh delicate serene and Fragrent, Regaling ye soul with all ye essences of natures preparations, yeilding a 1000 cordiall vitall smells, as a breath wafted from Paradise, Pacific Repose of air, stuft with Richest odoriferous effluvia, and heightned with a celestiall illapsed Flavour, Body of Botanic perfumes and Relishes raised by and now showring down in cool and Precious bath of dew: Flower and choicest concocted honey of ye day. ."

Whiston's most vivid passage describes the great thunderstorm of September 10th.

Some outstanding features of the year were:—

July	12th, 13th and 14th	Hottest days almost ever known.
Aug.	25th	Exceptional visibility.
Aug.	27th, 28th and 29th	Early heavy frosts (with ice).
Sept.	10th	Violent thunderstorm raged.
Nov.	10th, 11th and 12th	Floods after much rain.
Nov.	18th	Tempestuous wind.
Nov.	25th	Violent wind and storm.
Nov.	26th	High wind and heavy rain.
Nov.	27th	Hurricane and rain causing floods.
Dec.	14th	Thick fog, very hard frost and ice.
Dec.	15th	Thick fog, very hard frost and ryme.
Dec.	20th	Exceptionally hard frost.

At the end of the volume there is a "General supplement and application of the year," treating of the price of grain—hay—fruit—sheep—season and temperature. The last item is an "Essay Philosophicall of Cause of unequall Growth in Vegetables."

Review

The Evolution of Climates. By Marsden Manson. 8vo. 9¼ by 6¼, pp. 66. Baltimore. The Lord Baltimore Press, 1922.

THE author of this little book has seized upon a few fundamental facts of geological history, and has drawn from them some

far-reaching conclusions. Terrestrial climate, as is well known, has passed through a number of vicissitudes, in which long spells of mild conditions have alternated with short periods of glaciation, including two of outstanding importance—the Permo-Carboniferous and the Quaternary. The Quaternary glaciation developed mainly in cold-temperate latitudes, and has generally been accepted as having occurred under modern zonal conditions, slightly modified towards a lower temperature or an increased snowfall. The Permo-Carboniferous glaciation developed in low latitudes, while high latitudes escaped, and has hitherto defied adequate explanation. Another fact, which has received less attention, is that throughout the long course of geological history these were the only occasions on which a zonal differentiation of climate was manifest, and, except for a few small fluctuations, the oceans appear to have been uniformly warm throughout.

We know that the surface of the larger planets is covered by an almost unbroken layer of cloud, and the author assumes that this must have been the case with the earth also in past times, and in fact comparatively recently. Through this cloud canopy the sun's rays could not penetrate, and as a factor in meteorology the sun was almost inoperative. The earth was radiating more than it was absorbing, and the sources of this outgoing energy were the original supply of earth-heat and radio-active minerals. Owing to the poorly conducting crust earth-heat was liberated, not in a steady stream, but in spasms during periods of volcanic action and crustal movement.

Let us start with one of these liberations of earth heat. Within its protecting cloud canopy the surface, oceans and continents alike, was warm from equator to poles, but the land surfaces cooled more quickly than the heat-conserving oceans, and in due course, while the warm oceans were still supplying enough moisture to maintain the cloud canopy intact, the land surfaces began to freeze and ice-sheets developed. Apart from some local glaciations in the centres of the larger continents this stage was first reached on a planetary scale in the Permo-Carboniferous period; this glaciation coincided more or less with the present sub-tropical high pressure belts, and the reason is stated to be that "cold anticyclonic winds" cooled the land most rapidly in those belts. The cooling of the oceans continued, and, with decreasing evaporation, a stage was reached in which these high pressure areas, to-day possessing the clearest skies of the world, ceased to be mantled in clouds, the sun broke through and deglaciation commenced.

Now followed a period of dual control, solar energy prevailing near the equator, earth-heat towards the poles. In spite of fluctuations the latter gradually diminished, and just before the Pleistocene glaciation the polar oceans became cold

for the first time. Then the second planetary glaciation occurred, centred in the cold temperate belts of greatest precipitation, at this time the only regions which were permanently overcast. The cooling of the oceans continued, and evaporation ceased to supply enough moisture for even this limited cloud belt, the sun shone over the whole world, deglaciation again commenced and is still continuing.

The theory is interesting, but meteorologists will find some insuperable difficulties. With warm oceans and an unbroken cloud canopy the land surfaces, unless at an immence altitude, could not possibly freeze ; the conditions are most nearly realised at present in the equatorial rain belt, in which the land is maintained at the same temperature as the neighbouring oceans. " Cold anticyclonic winds " presuppose cooling by radiation ; even if under world-wide isothermal conditions the pressure distribution could remain unaltered, which is highly improbable, we must suppose either that the anticyclone would break down the cloud canopy, in which case the tropical sun would certainly prevent glaciation, or that the clouds would remain in spite of the anticyclone, in which case the descending air would not be cold. There are also geological difficulties, such as the existence even in very early geological times of " fossil deserts," which could hardly have been found without solar control and clear skies. Past weather must have differed from present weather, just as past geography has differed from present geography, but we cannot accept such radical changes in the laws of meteorology as are set out in this book. C.E.P.B.

Obituary

Mr. Richard Strachan.—At the advanced age of 90 Mr. Richard Strachan died on Easter day, April 20th, 1924. Strachan was educated at the Greenwich Hospital Nautical School, and afterwards taught Navigation at the Sailors' Home, Poplar. He entered the Board of Trade, and was soon transferred to the Meteorological Department organised under the superintendence of Admiral FitzRoy in 1855, being responsible for work in connection with the supply to ships of the Royal Navy and mercantile marine of the instruments required for the keeping of meteorological logs. The Meteorological Register, which he designed for the use of private observers, was first published about the end of 1863 and is still in use.

In 1864 a monthly journal, *The Meteorological Magazine*, was started. The magazine was " printed and published for the proprietors " by Williams and Strahan. There is no statement in the magazine as to the identity of the proprietors, but it is understood that credit must be given to Strachan for initiating the enterprise as well as for his excellent work as editor. The

only four numbers of the magazine to be published are still of great interest, and it must have been very disappointing to Strachan to find that for lack of financial support publication could not be continued. Two years later Symons started *Symons's Meteorological Magazine* on more modest lines and was able to make it a success. The present *Meteorological Magazine* is, of course, the sequel to Symons's.

Strachan was elected a Fellow of the Royal Meteorological Society in 1865, and was a Fellow for nearly 60 years; he served on the Council, and contributed several communications to the Society's Journal. He also contributed many articles to the *Horological Journal*, chiefly on meteorological instruments. He carried out several official discussions, notably those embodied in the series of reports on the weather of the Arctic and Antarctic regions which he compiled from the observations of early navigators. Strachan retired from the Meteorological Office in 1900 after long and meritorious service. Ten years after his retirement he published a collection of essays on meteorological subjects, and, indeed, until comparatively recently, he showed his vigour by taking part in the discussions at the Meteorological Office.

News in Brief

We regret to learn of the death, at Vienna, of Professor F. H. Bigelow, late Professor of Meteorology in the Argentine Meteorological Office.

We are informed that Professor Pilgrim, Director of the Meteorological Department of the Würtemberg Statistical Office, and Professor Meyer, Director of the Würtemberg State Meteorological Office, have retired, and that Professor E. Kleinschmidt has been appointed in succession to them both.

In a match between the Air Ministry and War Office Chess Clubs, the Air Ministry won by five games to one. Three out of the six players in the Air Ministry team were from the Meteorological Office, and all won.

According to the *Daily Chronicle* the local "experts" at Pantchevo, near Belgrade, have declared that, since the establishment of an important air station there, there has been an extraordinary absence of any normal rainfall, and an inquiry has been begun by the Academy of Science in Belgrade.

The official times for the explosions at La Courtine (*vide M.M.*, April, 1924, p. 49) are as follows:—May 15th, 7.30 p.m., May 23rd, 8.0 p.m., May 25th, 9.0 p.m. British Summer Time. The air-waves should take about 30 minutes to reach the south of England.

On April 16th at 11h. 30m. (G.M.T.), a waterspout in the whirling spray stage was observed in the harbour at Stornoway. It was travelling seawards. The base was about 10 feet across, and the height up to 50 feet. During the previous few days the weather had been very wild, and on the day of the observation hail showers occurred with a NNW wind, force 8 or 9, in squalls.

The Weather of April, 1924

WITH the exception of a spell of warm sunny weather at Easter the conditions during April were generally cloudy and cool. At the beginning of the month, pressure was high over Scotland, and a few days of bright sunshine were experienced in the west and north, but, after the 4th, the high pressure withdrew westwards to the Atlantic, and then moved south, giving cool northerly winds, backing to west over the whole kingdom. Very little precipitation occurred during this period, there being only slight showers of snow, sleet or hail at a few places. Temperature was low generally, but rose to about 60° F. in parts of eastern England and the Midlands. On the 7th, at Geldeston (near Beccles) and at Scarborough, 63° F. was reached. Subsequently a cold current from Arctic regions spread down the western coasts of Europe and caused a renewal of cool weather. Secondary depressions developed near the Hebrides and were associated with considerable rain, snow, sleet and local thunderstorms as they moved south-east. Meanwhile further depressions were approaching from the Azores. On the night of the 8th-9th, 3 inches of snow fell at Achnashellach, followed by 2½ inches on the night of the 10th-11th, and "snow lying" was reported from a few stations for several days. Rain fell repeatedly further south; 71 mm. (2·80 ins.) at Holne (Devon) and 52 mm. (2·03 ins.) at Tynywaun (Glamorgan), on the 13th, were among the largest amounts recorded. On the 16th an anticyclone spread northwards from France, and fine sunny warm weather prevailed (except in the extreme north) from then until after Easter. Temperature rose above 60° F. on the 18th, 19th and 20th, and reached 76° F. at Greenwich and 75° F. at S. Farnborough on the 21st (Easter Monday). After this, further depressions approaching from the Atlantic brought a renewal of cloudy, rainy conditions, though bright intervals intervened. Thunderstorms occurred locally in southeast and east England on the 26th, and gales were experienced in the English Channel on the 27th. The heavy rains during the latter part of the month brought the total precipitation for the month up to 189 mm. (7·45 ins.) at Cray (Brecon) and to 164 mm. (6·46 ins.) at Blaenau (Brecon). At Kew Observatory the total of 87 mm. has only once (in 1878) been exceeded in April since 1866.

The outstanding feature of weather abroad during the early part of April was the continuation, over various parts of Europe and America, of the heavy rainfalls and flood of the latter part of March. In Italy heavy rain and hail storms caused considerable damage and loss, and the River Po rose steadily. In Switzerland heavy falls of snow caused obstruction in many of the Alpine passes, but the floods caused at the end of March by the melting of the snow, were checked by the low temperature which prevailed during the first days of the month. The torrential rains reported last month in Spain have caused extensive landslides in the province of Granada: olive groves have moved downhill and many buildings have collapsed. Seville was flooded and many lives lost. At Rio de Janeiro nine and a half inches of rain were reported to have fallen in five hours on the 4th. Several lives were lost through the floods and the consequent collapse of small houses.

Bengal was suffering from exceptionally early hot, dry weather in March, and no relief was felt this month, very high temperatures being recorded during the first week. In Calcutta temperature in the shade exceeded 110° F. on some occasions. On April 25th, at Pihani, in the Hardoi district of Oudh, India, a tornado, about 300 yards in diameter, swept from west to east for a distance of six miles. Three villages were destroyed, and many people killed.

Towards the end of the month severe storms were experienced on the north-western and northern coasts of Europe. On the 30th a series of tornadoes swept across the south-eastern United States from Louisiana to Virginia. The storms were most violent in South Carolina, Alabama and Georgia. The town of Fickling in Georgia is reported to have been entirely destroyed. Many lives were lost.

The special message from Brazil states that in the north there was a great deficit of rain in the Amazon and Para States, but that in the other States the rainfall was unusually heavy, being over 200 mm. above normal. Disastrous floods occurred with much loss of life in all the States, including the drought region. In central and southern Brazil the rainfall was very irregular and the averages were 17 mm. under and 32 mm. above normal respectively. The cotton crop is badly affected by the boll weevil. At Rio de Janeiro pressure was 0·9 mm. under normal for the month, and temperature 0·8° C. above normal.

Rainfall April, 1924: General Distribution

England and Wales	145	per cent. of the average 1881-1915.
Scotland	95	
Ireland	125	
British Isles	128	

Rainfall: April, 1924: England and Wales.

CO.	STATION.	In.	mm.	Per-cent. of Av	CO.	STATION.	In.	mm.	Per-cent. of Av.
Lond.	Camden Square.....	3·14	80	204	*War.*	Birminghm, Edgbaston	3·04	77	175
Sur .	Reigate, Hartswood...	3·50	89	226	*Leics*	Leicester Town Hall...	1·95	49	...
Kent.	Tenterden, View Tower	2·95	66	182	,, .	Belvoir Castle.....	1·67	42	109
,, .	Folkestone, Boro. San.	2·34	59	...	*Rut .*	Ridlington.....	2·19	56	...
,, .	Broadstairs	2·09	53	151	*Linc.*	Boston, Skirbeck	1·80	46	133
,, .	Sevenoaks, Speldhurst.	4·01	102	...	,, .	Lincoln, Sessions House	1·32	33	95
Sus .	Patching Farm.....	3·04	77	174	,, .	Skegness, Estate Office.	1·49	38	111
,, .	Eastbourne, Wilm. Sq.	1·59	66	87	,, .	Louth, Westgate	1·65	42	99
,, .	Tottingworth Park....	3·64	93	197	,, .	Brigg	1·22	31	78
Hants	Totland Bay, Aston...	2·53	64	154	*Notts.*	Worksop, Hodsock....	1·42	36	97
,, .	Fordingbridge, Oaklnds	3·53	90	193	*Derby*	Mickleover, Clyde Ho..	2·38	61	138
,, .	Portsmouth, Vic. Park.	2·46	62	157	,, .	Buxton, Devon. Hos...	2·68	68	91
,, .	Ovington Rectory	4·16	106	220	*Ches.*	Runcorn, Weston Pt...	2·27	58	131
,, .	Grayshott	3·84	98	196	,, ..	Nantwich, Dorfold Hall	2·01	51	...
Berks	Wellington College...	3·28	83	204	*Lancs*	Bolton, Queen's Park .	2·06	52	...
,, .	Newbury, Greenham..	3·34	85	183	,, ..	Stonyhurst College....	1·80	46	66
Herts.	Bennington House....	2·93	74	192	,, ..	Southport, Hesketh...	1·43	36	77
Bucks	High Wycombe	3·39	86	216	,, ..	Lancaster, Strathspey.	1·65	42	...
Oxf..	Oxford, Mag. College..	2·45	62	159	*Yorks*	Sedbergh, Akay	2·59	66	80
Nor .	Pitsford, Sedgebrook..	3·02	77	196	,, .	Wath-upon-Dearne ...	1·52	39	96
,, .	Eye, Northolm.....	1·65	42	...	,, .	Bradford, Lister Pk...	2·07	53	103
Beds.	Woburn, Crawley Mill.	2·97	75	198	,, .	Oughtershaw Hall	3·15	80	...
Cam.	Cambridge, Bot. Gdns.	2·88	73	212	,, .	Wetherby, Ribston H..	1·66	42	94
Essex	Chelmsford, CountyLab	3 16	80	...	,,	Hull, Pearson Park ...	1·49	38	95
,, .	Lexden, Hill House...	2·62	67	...	,, .	Holme-on-Spalding ...	1·93	49	...
Suff .	Hawkedon Rectory ...	2·64	67	171	,, .	Lowthorpe, The Elms.	1·74	44	104
,, .	Haughley House.....	2·42	61	...	,, .	West Witton, Ivy Ho..	1·90	48	...
Norf.	Beccles, Geldeston....	2·42	61	165	,, .	Pickering, Hungate ...	2·10	53	...
,, .	Norwich, Eaton	2·05	52	120	,, .	Middlesbrough	1·79	45	131
,, .	Blakeney	1·48	38	116	,, .	Baldersdale, Hury Res.	2·08	53	87
,, .	Swaffham	2·18	55	147	*Durh.*	Ushaw College	1·75	44	93
Wilts.	Devizes, Highclere....	3·27	83	172	*Nor .*	Newcastle, Town Moor.	1·71	43	104
Dor .	Evershot, Melbury Ho.	3·71	94	157	,, .	Bellingham Manor....	1·59	40	...
,, .	Weymouth, Westham..	2·49	63	150	,, .	Lilburn Tower Gdns...	1·49	38	...
,, .	Shaftesbury, Abbey Ho.	2·73	69	128	*Cumb*	Penrith, Newton Rigg..	1·85	47	89
Devon	Plymouth, The Hoe...	3·34	85	151	,, .	Carlisle, Scaleby Hall .	1·99	50	102
,, .	Polapit Tamar	3·94	100	168	,, .	Seathwaite	5·75	146	77
,, .	Ashburton, Druid Ho..	5·54	141	182	*Glam.*	Cardiff, Ely P. Stn....	3·40	86	134
,, .	Cullompton	3·73	95	164	,, .	Treherbert, Tynywaun	8·15	207	...
,, .	Sidmouth, Sidmount ..	2·78	71	131	*Carm*	Carmarthen Friary....	4·33	110	158
,, .	Filleigh, Castle Hill ...	3·70	94	...	,, .	Llanwrda, Dolaucothy.	5·15	131	156
,, .	Hartland Abbey.....	2·76	70	...	*Pemb*	Haverfordwest, Portf'd	...	...	...
Corn.	Redruth, Trewirgie ...	3·99	101	138	*Card.*	Gogerddan.....	2·54	65	97
,, .	Penzance, Morrab Gdn.	2·95	75	121	,, .	Cardigan, County Sch. .	3·33	85	...
,, .	St. Austell, Trevarna..	3·65	93	129	*Brec .*	Crickhowell, Talymaes	4·00	102	...
Soms	Chewton Mendip	5·16	131	174	*Rad .*	Birm.W.W.Tyrmynydd	5·72	145	155
,, .	Street, Hind Hayes ...	2·46	63	...	*Mont.*	Lake Vyrnwy	4·89	124	162
Glos..	Clifton College	3·25	83	151	*Denb.*	Llangynhafal	1·83	47	...
,, .	Cirencester	2·91	74	152	*Mer .*	Dolgelly, Bryntirion..	4·66	118	128
Here .	Ross, County Obsy. ...	2·49	63	132	*Carn.*	Llandudno	2·01	51	111
,, .	Ledbury, Underdown.	2·87	73	158	,, .	Snowdon, L. Llydaw 9	9·07	230	...
Salop	Church Stretton.....	4·10	104	190	*Ang .*	Holyhead, Salt Island.	2·81	71	135
,, .	Shifnal, Hatton Grange	3·30	84	196	,, .	Lligwy	2·42	61	...
Staff.	Tean, The Heath Ho...	3·03	77	152	*Isle of Man*				
Worc.	Ombersley, Holt Lock.	2·92	74	192		Douglas, Boro, Cem...	3·75	95	154
,, .	Blockley, Upton Wold.	4·28	109	221	*Guernsey*				
War.	Farnborough.....	3·14	80	160		St. Peter Port Grange .	3·34	85	166

Rainfall: April, 1924: Scotland and Ireland.

CO.	STATION.	In.	mm.	Per-cent. of Av.	CO.	STATION.	In.	mm	Per-cent of Av.
Wigt.	Stoneykirk, Ardwell Ho	2·67	68	127	*Suth.*	Melvich School.....	2·39	61	103
,, .	Pt. William, Monreith .	1·90	48	...	*Caith*	Loch More, Achfary...	5·74	146	118
Kirk.	Carsphairn, Shiel.	3·83	97	...	,, .	Wick	1·03	26	52
,, .	Dumfries, Cargen.....	3·33	85	125	*Ork .*	Pomona, Deerness	1·81	46	87
Dum	Drumlanrig	3·00	76	122	*Shet .*	Lerwick	5·41	137	237
Roxb	Branxholme	1·73	44	91	*Cork.*	Caheragh Rectory	4·81	122	...
Selk .	Ettrick Manse.....	3·75	95	...	,, ..	Dunmanway Rectory.	3·80	97	92
Berk.	Marchmont House	1·24	31	61	,, ..	Ballinacurra	2·14	54	83
Hadd	North Berwick Res....	0·76	19	54	,, ..	Glanmire, Lota Lo. ...	2·45	62	87
Midl	Edinburgh, Roy. Obs..	1·04	26	76	*Kerry*	Valencia Obsy.	3·06	78	83
Lan .	Biggar	1·52	39	88	,, .	Gearahameen	6·50	165	...
Ayr .	Kilmarnock, Agric. C..	2·25	57	109	,, .	Killarney Asylum.....	3·03	77	92
,, .	Girvan, Pinmore.....	5·45	138	183	,, .	Darrynane Abbey	2·02	51	59
Renf.	Glasgow, Queen's Pk..	2·14	54	109	*Wat .*	Waterford, Brook Lo..	2·73	69	107
,, .	Greenock, Prospect H..	3·42	87	94	*Tip .*	Nenagh, Cas. Lough...	3·16	80	126
Bute.	Rothesay, Ardencraig.	3·81	97	128	,, .	Tipperary	2·32	59	...
,, .	Dougarie Lodge	3·59	91	...	,, .	Cashel, Ballinamona ..	2·44	62	98
Arg .	Glen Etive.....	5·21	132	...	*Lim .*	Foynes, Coolnanes	3·05	77	125
,, .	Oban	3·10	79	...	,, .	Castleconnell Rec.	3·32	84	...
,, .	Poltalloch	3·67	93	125	*Clare*	Inagh, Mount Callan ..	3·12	79	...
,, .	Inveraray Castle.....	4·21	107	92	,, .	Broadford, Hurdlest'n.	4·00	102	...
,, .	Islay, Eallabus.....	3·88	99	135	*Wexf*	Newtownbarry	3·61	92	...
,, .	Mull, Benmore	8·70	221	...	,, .	Gorey, Courtown Ho...	2·58	65	118
Kinr.	Loch Leven Sluice	1·65	42	86	*Kilk.*	Kilkenny Castle	2·35	60	108
Perth	Loch Dhu	4·95	126	104	*Wic .*	Rathnew, Clonmannon	2·86	73	...
,, ..	Balquhidder, Stronvar.	3·14	80	70	*Cars.*	Hacketstown Rectory .	3·46	88	131
,, ..	Crieff, Strathearn Hyd.	2·84	72	130	*QCo..*	Blandsfort House.....	3·20	81	123
,, ..	Blair Castle Gardens ..	1·76	45	...	,,	Mountmellick	2·86	73	...
,, .	Coupar Angus School..	1·51	38	91	*KCo.*	Birr Castle.....	3·31	84	154
Forf.	Dundee, E. Necropolis.	1·83	47	108	*Dubl.*	Dublin, FitzWm. Sq...	1·70	43	89
,, .	Pearsie House.....	2·20	56	...	,, .	Balbriggan, Ardgillan .	2·81	71	142
,, .	Montrose, Sunnyside..	1·56	40	86	*Me'th*	Drogheda, Mornington	2·45	62	...
Aber.	Braemar Bank	1·55	39	67	*W.M*	Mullingar, Belvedere	3·68	93	155
,, .	Logie Coldstone Sch. ..	1·24	31	62	*Long*	Castle Forbes Gdns....	4·18	106	175
,, .	Aberdeen, Cranford Ho	1·92	49	94	*Gal .*	Galway, Waterdale ...	2·20	56	...
,, .	Fyvie Castle	0·90	23	...	,, .	Ballynahinch Castle ..	4·52	115	...
Mor .	Gordon Castle.....	0·88	22	50	*Mayo*	Mallaranny.....	3·55	90	...
,,	Grantown-on-Spey....	0·47	12	24	,, .	Westport House.....	2·66	68	98
Na .	Nairn, Delnies.....	0·50	13	33	,, .	Delphi Lodge	5·21	132	...
Inv..	Ben Alder Lodge	2·31	59	...	*Sligo*	Markree Obsy.	4·75	121	180
,, .	Kingussie, The Birches	1·23	31	...	*Ferm*	Enniskillen, Portora ..	4·36	111	...
,, .	Fort Augustus	1·71	43	67	*Arm.*	Armagh Obsy.	2·51	64	119
,, .	Loch Quoich, Loan....	9·30	236	...	*Down*	Warrenpoint	3·32	84	...
,, .	Glenquoich	...	...	...	,, .	Seaforde	3·94	100	150
,, .	Inverness, Culduthel R.	0·80	20	...	,, .	Donaghadee	2·58	66	129
,, .	Arisaig, Faire-na-Squir	...	...	...	,, .	Banbridge, Milltown .	2·37	60	116
,, .	Fort William.....	3·26	83	74	*Antr.*	Belfast, Cavehill Rd..	3·38	86	...
,, .	Skye, Dunvegan.....	2·89	73	...	,, .	Glenarm Castle.....	2·53	64	...
,, .	Barra, Castlebay	1·87	47	...	,, .	Ballymena, Harryville	2·48	63	94
R&C	Alness, Ardross Cas. ..	1·47	37	61	*Lon .*	Londonderry, Creggan	4·13	105	161
,, .	Ullapool.....	2·59	66	...	*Tyr .*	Donaghmore	3·22	82	...
,, .	Torridon, Bendamph..	4·45	113	85	,, .	Omagh, Edenfel.....	3·32	84	126
,, .	L. Carron, Plockton...	3·38	86	...	*Don .*	Malin Head	3·67	93	186
,, .	Stornoway	2·87	73	95	,, .	Rathmullen.....	...	...	...
Suth.	Dunrobin Castle.....	...	...	...	,, .	Dunfanaghy	4·66	118	173
,, .	Lairg	1·91	49	...	,, .	Narin, Kiltoorish	4·47	113	...
,, .	Tongue Manse.....	2·51	64	96	,, .	Killybegs, Rockmount.	6·98	177	194

Ballynahinch, Jan. 6·82 ins., 173 mm., Feb. 2·70 ins., 69 mm., Mar. 3·30 ins., 84 mm.

Climatological Table for the British Empire, November, 1923

STATIONS	PRESSURE		TEMPERATURE							Relative Humidity	Mean Cloud Am'nt	PRECIPITATION			BRIGHT SUNSHINE	
			Absolute		Mean Values				Mean							
	Mean of Day M.S.L.	Diff. from Normal	Max.	Min.	Max.	Min.	½ max. and min.	Diff. from Normal	Wet Bulb.			Am'nt	Diff. from Normal	Days	Hours per day	Percentage of possible.
	mb.	mb.	° F.	° F.	° F.	° F.	° F.	° F.	° F.	%	0—10	mm.	mm.			
London, Kew Obsy.	1009·2	— 5·4	58	23	44·2	33·3	38·7	— 5·3	37·9	85	6·4	37	— 19	11	2·4	28
Gibraltar	1015·0	— 1·5	72	46	63·8	52·1	57·9	— 1·8	54·2	76	5·3	217	+ 56	12	...	...
Malta	1016·0	+ 0·3	77	57	70·2	62·3	66·2	+ 3·2	61·1	77	5·9	95	+ 14	10	5·5	54
Sierra Leone	1011·7	+ 0·9	91	71	87·9	74·0	80·9	— 0·3	76·2	78	4·9	122	— 12	16	...	...
Lagos, Nigeria	1009·7	— 1·1	90	71	88·5	76·6	82·5	+ 1·2	78·3	75	6·5	69	+ 3	6	...	...
Kaduna, Nigeria	1013·7	+ 2·4	94	...	90·5	...	...	...	67·0	53	2·5	0	— 1	0	...	...
Zomba, Nyasaland	1007·9	— 1·1	100	63	91·7	68·6	80·1	+ 5·0	...	81	3·3	6	—136	3	...	...
Salisbury, Rhodesia	1007·0	— 3·0	99	51	91·8	58·6	75·2	+ 4·3	63·1	42	3·3	20	— 72	6	...	...
Cape Town	1014·8	— 0·9	88	50	74·3	57·4	65·9	+ 2·8	62·5	70	4·7	82	+ 55	8	...	...
Johannesburg	1009·9	— 0·5	89	49	78·5	56·7	67·6	+ 4·2	56·3	52	4·5	113	+ 5	13	8·7	65
Mauritius	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Bloemfontein	...	...	93	43	83·7	55·5	69·6	+ 1·2	57·4	47	4·1	72	+ 14	5	...	...
Calcutta, Alipore Obsy.	1012·4	— 0·9	89	53	83·2	65·3	74·3	+ 1·2	65·3	77	4·5	18	+ 4	*1	...	...
Bombay	1011·4	— 0·5	92	67	86·4	72·4	79·4	— 0·9	69·5	75	1·8	0	— 10	*0	...	...
Madras	1011·1	— 0·2	92	66	86·3	72·5	79·4	+ 0·7	73·9	77	4·7	92	—233	*4	...	...
Colombo, Ceylon	1010·6	+ 0·5	88	72	86·0	73·9	79·9	— 0·4	76·7	71	7·9	222	— 85	24	6·9	58
Hong Kong	1016·0	— 1·6	83	60	75·6	68·3	71·9	+ 2·2	65·7	72	5·2	10	— 26	2	6·7	61
Sandakan	...	...	90	73	86·8	75·1	80·9	— 0·1	76·8†	80†	...	224	—149	14	...	...
Sydney	1012·3	— 1·4	100	49	74·4	56·2	65·3	— 1·7	57·0	58	3·4	35	— 38	8	10·4	75
Melbourne	1013·1	— 1·1	101	42	68·8	50·0	59·4	— 1·9	52·9	57	6·0	71	+ 15	17	...	...
Adelaide	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Perth, W. Australia	1016·9	+ 1·6	95	47	77·7	55·6	66·7	+ 0·9	58·6	60	3·2	1	— 19	1	9·2	67
Coolgardie	1014·4	+ 1·3	107	44	88·7	57·5	73·1	+ 2·3	60·1	31	2·7	0	— 17	0	...	...
Brisbane	1013·4	— 0·9	95	58	82·3	64·2	73·3	— 0·3	66·4	62	3·8	31	— 61	9	9·4	70
Hobart, Tasmania	1008·3	— 1·1	84	38	62·2	46·9	54·5	— 2·7	49·5	65	7·4	173	+109	18	6·8	47
Wellington, N.Z.	1017·2	+ 5·6	73	39	66·9	53·9	60·4	+ 3·5	54·8	68	5·9	19	— 73	8	7·2	50
Suva, Fiji	1010·6	— 0·5	84	63	80·3	69·4	74·9	— 2·3	71·9	75	7·0	348	+106	19	...	...
Kingston, Jamaica	1012·5	— 0·2	92	66	88·3	70·9	79·6	+ 0·3	...	70	5·5	30	— 50	2	...	...
Grenada, W.I.	1012·2	+ 1·6	88	73	85·2	74·7	79·9	+ 0·6	75·3	75	4·9	149	— 59	20	...	...
Toronto	1018·0	+ 1·2	58	22	45·1	33·0	39·1	+ 2·8	35·2	80	6·8	84	+ 9	11	2·6	27
Winnipeg	1014·4	— 2·3	64	2	42·5	26·2	34·3	+13·5	30·8	82	5·2	23	— 1	11	3·0	33
St. John, N.B.	1017·3	+ 3·4	57	15	45·7	33·0	39·3	+ 2·6	36·8	86	6·1	116	+ 4	10	3·0	32
Victoria, B.C.	1019·1	+ 3·6	57	36	50·7	42·9	46·8	+ 2·4	45·0	95	7·5	74	— 90	21	2·8	30

* For Indian stations a rain day is a day on which 0·1 in. (2·5 mm.) or more rain has fallen. † Mean of observations at 9h., 15h., 21h., from April, 1923.

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The Magazine may also be purchased from THE METEOROLOGICAL OFFICE, SOUTH KENSINGTON, LONDON, S.W.7

World Weather*

By Lieut.-Col. E. GOLD, D.S.O., F.R.S.

DR. H. H. CLAYTON, Chief of the Forecast Department of the Argentine Weather Service, has been well known to meteorologists since he took charge of the expedition sent out in 1905 by Teisserenc de Bort and A. Lawrence Rotch to explore with kites the upper air over the Atlantic. His researches on the relations between solar conditions and the weather have been the subject of much discussion. It was therefore to be expected that his new book *World Weather*, would be fresh and interesting.

This book covers in fourteen chapters the whole range of meteorological science. It begins with an account of the forces controlling changes of the weather—proceeds to the simpler periodic changes—discusses temperature, pressure, wind and humidity. That takes eight chapters. Chapter nine treats of cyclones and anticyclones, "or storm and sunshine." (I do not think we in north-west Europe can regard anticyclones so benevolently.) In these nine chapters the author shows himself acquainted with recent developments in meteorology and gives prominence to the contributions of Shaw, Dines, Simpson, Taylor, Bjerknes and Emden, and naturally also to the work of many American meteorologists, including Dr. Le Roy Meisinger,

* *World Weather*, including a discussion on The Influence of Variations of Solar Radiation on the Weather, and of The Meteorology of the Sun, by Henry Helm Clayton. (Macmillan & Co. Price 18s.)

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whose recent untimely death at the post of duty we all deplore.

The effect of the earth's rotation on atmospheric motion which is fundamental in the meteorology of temperate latitudes, is considered at some length; in this connection the author attributes to W. M. Davis and Clough results about the motion of a particle on a level surface, which were published forty years earlier by Sprung and re-published in 1910 by the Smithsonian Institute. One notes also on page 43 Thompson should be Thomson. (James Thomson was Lord Kelvin's brother.)

The "sea-breeze" is a phenomena whose magnitude in some tropical regions I had not appreciated until I read the author's graphical description, taken from Bowman, of the sea-breeze of Chile and Peru, which reaches gale force daily in certain regions. It may prove possible for "gliders" to make use of this.

The longest two chapters of the book are devoted to a consideration of the relation between solar radiation and the weather. They are of great interest: much information has been collected and discussed and the fact that Dr. Clayton has himself contributed materially to this subject, enables him to write with confidence about it. He realises that no simple direct universal connection can be found (or expected) between the intensity of solar radiation and the temperature or weather at a place. The effect of a change of solar radiation depends on the period for which the excess or defect lasts and it varies with latitude and altitude and with the situation of the region in relation to the "centres of action." He has, however, arrived at the general conclusion that the effect of solar changes in the temperate zones begins to be felt first in high latitudes, progresses eastward and equator-ward and dies out in low latitudes.

He has something to say on the vexed question of periodicities (with special reference to solar periodicities) and gives a good account of the relation between long period variations of pressure in different latitudes and the variation of sunspots—in the tropics pressure is high at sunspot minima and low at sunspot maxima. In connection with the 11-year period of sunspots and temperature one feels that a fuller reference than the simple mention of the author's name might have been made to Newcomb's investigation. Hale's researches are referred to in Chapter XIV., which treats of the meteorology of the sun, but presumably this book was in print before the announcement of the most recent results of the examination of the bi-polar spots and their changes in each new cycle which puts future investigators in so much more favourable a position for the discussion of this period in World Weather.

In a chapter on Forecasting the author gives an account of forecasting from weather maps and, what will be of much interest to European readers, an account of forecasting in Argentina

from accurate observations of the intensity of solar radiation. The results of the trial were naturally not uniformly successful, but the author considers that when full and accurate day to day values of solar radiation are available, forecasting, not merely for Argentina but also for Europe and other parts of the world, will be possible with an accuracy not heretofore thought possible. Whether we are convinced of this or no, we are convinced that the trial is worth making and that all possible support ought to be rendered to Professor Abbot and his colleagues in their efforts to get such accurate day to day values. There will certainly be more light in many dark places of meteorology when a long series of such values are available.

Reading a book like *World Weather* makes me reflect that we meteorologists are apt to "spread ourselves"; we do not confine our attention to a single definite aim but, infected by our subject, we are led into mazes from which it is difficult to extricate ourselves and more difficult for our readers to find light. Dr. Helm Clayton has something special to say about world weather and its relation to solar changes, and I am inclined to think that concentration on that aspect of meteorology would have produced a result more satisfying to the expert meteorologist; but the book might then have proved less useful to the ordinary reader.

Royal Meteorological Society

THE monthly meeting of the Society was held on Wednesday, May 21st, at 49, Cromwell Road, South Kensington, Capt. C. J. P. Cave, President, in the Chair.

Messrs. J. E. Clark, I. D. Margary and Richard Marshall.—Report on the Phenological Observations in the British Isles from December, 1922, to November, 1923.

The three "phenological reporters" are to be congratulated on the production of an excellent report. Three hundred and fifty-seven records were dealt with in all, showing a more than 50 per cent. increase of the records since 1922. Only those whose duty it has been to analyse large masses of figures can assess at its true value the virtue of those who carry through such tasks for love.

It is interesting to recall that during last June there was a severe drought which accentuated the already bad conditions among the garden and field crops. Mid-July heat and thunderstorms partly made the conditions more favourable and finally crops in the more advanced parts surpassed expectation though much under average. In the extreme north, however, there

were reports of hay rotting and crops uncut in December, whilst the unprecedented November frosts destroyed hundreds of acres of undug potatoes even in Lincolnshire, Yorkshire and Lancashire.

C. E. P. Brooks, M.Sc.—The distribution of Rainfall over Uganda with a note on Kenya Colony.

The results of rainfall measurements at 51 stations in and near Uganda, mainly during the period 1901 to 1920 are discussed. The amounts vary from 31 to 76 inches a year, the mean being about 50 inches. The proportion of the rain which falls in the different seasons is illustrated by four seasonal maps, and by a diagram of the percentage which falls in each month in different latitudes. There are two rainy seasons, falling near the equinoxes on the equator but tending to approach the June solstice a few degrees north and the December solstice a few degrees south, so that in each hemisphere most of the rain falls in the summer half-year, and the rainy season each year "follows the sun" from south to north of the country and back again. Tables give the average monthly and annual rainfall and number of rain-days, the heaviest falls in a day, and the greatest and least monthly and annual falls, at the stations with the longest records. In these respect Uganda rainfall is moderate; more than five inches in a day is rare, and the heaviest monthly fall recorded is 17·85 inches. A brief description is also given of the rainfall over Kenya Colony, with a map of the average annual fall.

Spencer C. Russell, LL.B., exhibited a diagram showing daily records of well levels at Chilgrove, Sussex, and Detling, Kent, during 1923. The prolonged effects of the drought of 1921 make the diagram of special interest.

Correspondence

To the Editor, *The Meteorological Magazine*

The Storm in Somerset, May 18th, 1924

A VERY heavy hailstorm was experienced here at 17h. G.M.T. to-day.

Thunder and lightning commenced at 13h. followed by very heavy rain, thunder and lightning until 16h. 30m., when the rain stopped and the sky cleared somewhat to the south-west though continuing very heavy to the north and east with occasional thunder and lightning in those directions. At 16h. 45m. Cu-Nb cloud covered the sky except towards the west, where the sun was shining through Ci-St cloud, though patches of Cu-Nb were also seen in that direction, and vivid lightning and heavy thunder were experienced.

At 16h. 55m. a strange noise, as of heavy surf breaking on a shore, together with a whistling sound as of a gale, was heard high overhead and in a few seconds heavy rain drops, about the size of pennies, began to fall and increased in number, followed by very heavy hail. The hailstones were mostly round, but a number of eccentric shapes were noted, some being almost square. The round ones, on measurement, were $\frac{5}{8}$ inch in diameter and the square ones $\frac{3}{4}$ inch square. The stones were white in the centre and coated with transparent ice on the outside. The hail was so heavy that objects at a distance of 150 yards were cut off from view as by a white sheet, whilst branches were broken off trees, and glass roofs smashed. The hailstorm lasted 10 minutes, followed by rain for about 5 minutes. The fields were white for some time ; water rushed down any slopes, roads were flooded and from some fields the surface soil was carried down and silted up in ditches or against banks and hedges.

There was no wind at the surface either before or after the storm, thick ground mist being formed in low-lying ground.

S. N. PLUMMER.

Pratts Farm, North Petherton, Bridgewater, May 18th, 1924.

Looking along a Lightning Flash

MAY 8th, 1924, 4h. 45m., G.M.T. A brilliant flash of lightning, and before I could get my watch the violent crash of thunder had ceased. At the time I was at my window, and looking north-eastward exactly in line with the discharge, which seemed to me to have been immediately above a house not fifty yards distant. The one flash and its thunder crash constituted the entire storm.

Next morning I learned that a " bolt " had fallen on two houses; Nos. 34 and 35, Ventnor Villas were damaged, the latter seriously. Structural alterations of No. 35 were in progress, and Mr. Brown, the contractor, who had had 30 years of experience in the fire brigade, was present when the crash came, shortly before five o'clock was the nearest time he could give me. He laughed at the popular idea of a " bolt " having fallen. The flash of the lightning struck and fused the lead guttering on the north side of the house, pierced the wall, and on the inside split it downward into a room on the ground floor several steps above the pavement and street. It was in this room that the discharge took place, and such was the extraordinary manner in which the disruptive violence had exerted itself that Mr. Brown had never seen anything like it during his fire brigade service, the electricity, I should say, exercising its selective properties, destroying some things and leaving others untouched. About

one-half of the house was badly damaged, the whole of the chimney stack and cowls toppling over into the garden, a large area of the roof stripped, the north east angle of the house cut off, windows, a conservatory, and other things reduced to a mass of wreckage, and the neighbouring house, with the party wall in the side entrances separating them suffering considerable damage, but in neither building was any article set on fire. Strangely enough, although the families were in both houses, and the contractor and his men were leaving off work, no one suffered the slightest injury.

I think the main interest in it is the distance, 1 ml. 1 furlong, at which the explosion occurred, whereas a person making an estimate from his observation of the flash and the almost instantaneous crash of thunder would, like myself, guess it only just across the road, certainly less than 50 yards.

According to the *Sussex Daily News* two policemen said: "The lightning seemed to roll up in a ball and explode." My observation of the discharge was not that it was in the form of a globe, but looking upward, immediately above these Tennis Road houses, which are not 30 feet high, I saw close above me the underside of a brilliant disc from the circumference of which equally brilliant rays or shafts of light shot out. It is curious that for such a terrific crash there were no companion flashes, either preceding or following—it was a veritable bolt from nowhere, certainly not from the blue.

HY. HARRIES.

10, *Tennis Road, Hove, Brighton, May 10th*, 1924.

The Great Storm of May 31st, 1924
Rainfall at Ludlow, Salop

THE following figures relate to the intensities and quantities of rain which fell at Ludlow on the occasion of the great storm of Saturday night May 31st—June 1st. As I had no recording gauge I went to some trouble to take readings at short intervals, and the following forms a summary of the results.

The storm began at 7.57 p.m. on May 31st.

Time.	Quantity.	Total Time.	Total Quantity.
8·9 p.m. ..	0·65 inches	12 mins.	0·65 inches.
8·26 p.m. ..	0·63 ,,	29 ,,	1·28 ,,
8·36 p.m. ..	0·61 ,,	39 ,,	1·89 ,,
8·46 p.m. ..	0·30 ,,	49 ,,	2·19 ,,
8·57 p.m. ..	0·12 ,,	1 hr.	2·31 ,,
9·07 p.m. ..	0·12 ,,	70 mins.	2·43 ,,
9·57 p.m. ..	0·16 ,,	2 hrs.	2·59 ,,
10·27 p.m. ..	0·09 ,,	2½ hrs.	2·68 ,,
10·0 a.m. ..	1·63 ,,	14 hrs. 3 mins.	4·31 ,,
7·07 p.m. ..	0·52 ,,	23 hrs. 10 mins.	4·83 ,,
7·57 p.m. ..	nil.	24 hrs.	4·83 ,,

(NOTE.—The times are British Summer Time).

The greatest intensity occurred between 8.26 p.m. and 8.36 p.m., the fall of 0·61 inches during those 10 minutes being at the rate of 3·66 inches per hour.

The actual fall during the first hour of the storm amounted to 2·31 inches, and the 24 hours' total was 4·83 inches. The rainfall for the 31st May during the "official" hours ending 10 a.m. S.T. on 1st June amounted to 4·34 inches, made up of the 4·31 inches of the above table plus ·03 inches, which fell previously between 10·0 a.m. and 7·57 p.m. on the 31st. This latter quantity represents a slight shower about midday on the 31st together with the commencement of the rain from 7·50 to 7·57 p.m.

The afternoon and evening had been exceedingly sultry and oppressive, and warning of the storm was indicated by thunder in the direction of Church Stretton, but even so the actual burst of rain came with alarming suddenness. Within seven minutes of the first few drops of rain at 7.50 p.m. the intensity had reached tropical proportions, and, as indicated by the above table, this rate continued unabated for 39 minutes. There was lightning and heavy thunder from 8.10 p.m. to 8.35 p.m., after which there was only one isolated crash of thunder at 8.44 p.m. Rain continued steadily throughout the night and next day, and did not cease till 7.5 p.m. on June 1st—representing $23\frac{1}{4}$ hours continuous fall.

The total figure for the "official" 24 hours was very fortunately checked by a second gauge which I emptied twice. At 10.27 p.m. this gauge showed 2·66 inches since 10.0 a.m. on the 31st (against 2·68 + 0·03 = 2·71 inches) and at 10.0 a.m. on June 1st I found identical quantities in the two gauges, viz., 1·63 inches. Hence the second gauge gave 4·29 inches for the day as a check on the 4·34 inches of the first gauge.

The month's total which was only 3·57 inches up to 10.0 a.m. on the 31st was increased by this storm to 7·91 inches.

ALFRED A. BARNES, F.R.Met.Soc.

Roscrowden, Julian Rd., Ludlow, Salop, June 2nd, 1924.

Obituary

WE learn with deep regret of the death of Dr. C. Le Roy Meisinger and of his pilot Lieut. Neely during a thunderstorm which destroyed the balloon in which they were making observations over Bement, Illinois. They had been engaged in the series of flights for meteorological purposes which were described by Dr. Meisinger in the April number of the *Meteorological Magazine* and it is believed the balloon which exploded and burst into flames was struck by lightning.

NOTES AND QUERIES

Sir Gilbert T. Walker

IT was announced in the list of Honours awarded on the occasion of the King's Birthday that a knighthood had been conferred on the retiring Director-General of Observatories, India. Dr. Walker, who had been Director-General for 20 years, retired in the middle of June.

India has been particularly fortunate in her meteorologists, for Walker followed Eliot, and Eliot followed Blanford, and these three have made her meteorological service one of the best in the world. As is well known, Sir Gilbert has been a pioneer in the application of mathematical methods to meteorological statistics, and has made the subject of seasonal forecasts by these methods particularly his own. During the twenty years he has been in India he has written nine papers for the *Indian Meteorological Memoirs* on the correlation between meteorological factors and seasonal variations of weather, necessitating the calculation of well over a thousand correlation coefficients. Walker would not claim to have solved the problem of forecasting the rainfall of the Indian Monsoon, but there is little doubt that he has pointed the path to the solution and has had no little success himself.

The twenty years that Dr. Walker has been in India have been particularly difficult, especially on the administrative side. The Indian Meteorological Department was at its high-water mark in 1908, when Dr. Walker had four Europeans under him in Simla, two at Kodaikanal, and three European part-time officers at Madras, Bombay and Calcutta. Slowly these have been replaced by Indians, and now there are only three Europeans in the whole department, including the new Director-General himself. The war, followed by general unrest in India and great financial stringency, has resulted in a marked curtailment of the work of the meteorological department during recent years.

G. C. S.

The New Director-General of Observatories, India

Mr. J. H. Field, who is to be the new Director-General of Observatories, went out to India in 1904 as one of the three Imperial Meteorologists appointed to the reorganised department under Dr. Walker. Mr. Field has specialised on the upper air, and we owe to him all the knowledge we possess of the atmospheric conditions in the free air over India. Working first with kites,

he determined the depth of the monsoon current near Karachi. Kites, however, proved very difficult to use in India, where there is either no wind at all, or high winds and rain associated with the monsoon. Mr. Field has remarkable mechanical ability and much resource. He soon developed methods for using sounding balloons in the peculiar conditions in India, and succeeded in reaching great heights. Unfortunately, owing to the difficulties of staff and money of recent years this work has only just been published.

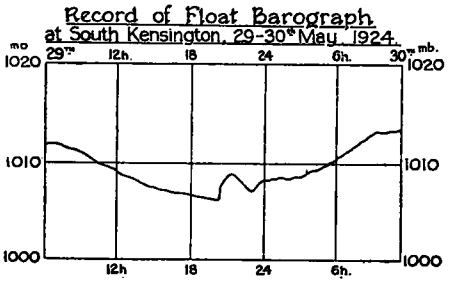
In consequence of the success of Mr. Field's preliminary work, the Aerological Observatory at Agra was established, and he was appointed Director. From 1912 to 1922 Mr. Field remained at Agra, but in the latter year he returned to Simla to help with the administration work at Headquarters, which was seriously affected by the loss of the European staff.

We wish Mr. Field all success in his new work.

G.C.S.

The Line Squall of May 29th, 1924

A WELL developed line squall passed across south-east England in the evening of May 29th. The first report of it was received at the Meteorological Office in a telegram from Ditcham Park, Petersfield. The absence of rain during the early phase of the squall was a marked feature of the phenomenon. In London the rain and thunder came after the squall cloud had passed. The sequence of pressure and temperature changes were somewhat unusual suggesting the temporary intrusion of a tongue of cold air and the resumption after an interval of two hours of the interrupted gradual change of pressure. The barogram for South Kensington is reproduced above.



The following notes on the passage of the squall have been contributed by different observers:—

East shore of Selsey Bill. Afternoon until about 17h. Dull threatening sky. Sultry air. Light wind from east.

17h.—17h. 45m. Continuing as above with some thunder from southwest and intermittent rain drops.

17h. 45m. Marked change in sky towards the southwest, a continuous bank of cloud, lighter in colour than the remaining sky, seen advancing from southwest.

17h. 50m. The bank of cloud quite near and stretching low down across the sky from southeast to northwest with peculiar irregular vertical breaks. As the cloud passed overhead continuous rain commenced and the wind veered to south, later to southwest. Rain increased. Wind force 5-6.
18h.—19h. Thunder and lightning towards south as storm passed in southerly direction and heavy rain continuing.
19h.—21h. Rain gradually lessening and wind northwest dying away. Sky clearing. HAROLD NOTLEY.

Wembley Exhibition. At about 19h. 30m. I noticed very heavy Cu. Nb cloud coming up rapidly from the south. The zenith was very angry-looking but in the north and northeast the sky was only partly covered with Alto Cu. cloud. Suddenly it got as pitch as it could be and a furious wind got up and drove the dust in great rolling clouds over the Exhibition. The dust blotted out everything and then it suddenly lightened in the south and the darkness was not so great. Not a drop of rain fell and I observed one distant lightning flash. There was no thunder. The wind blew hard for some time and then at about 20h. it pelted with rain and continued on and off for about 1½ hours. J. E. COWPER.

Leytonstone. At 8h. 55m. when the sky was entirely overcast (very black clouds being to the south of Leytonstone), there suddenly appeared a large white circle in the clouds, travelling towards us and getting larger at a very rapid rate. It had passed over our heads within 30 seconds. With it came a high wind drawing up dust from the Wanstead Flats, 300 ft. or more, entirely hiding from view all trees, etc. In 5 minutes everything had cleared. Heavy rain followed.

A K. TURNER.

The "Worcester," Greenhithe. During the day, the wind was ENE, force 2-4, barometer falling steadily, warm and sunny.

7h. 35m. Wind ENE, force 3, dry bulb 61°F., wet bulb 60°F. Cloud Ci.-Cu., Cu. & St. Sky quite overcast. Observed heavy Cu-Nb. clouds banking in the SW and travelling rapidly against wind from (roughly) SW to NE.
7h. 45m. Line squall front reached ship; wind suddenly came out of the south with force 10. For about three minutes this force was sustained, while a long line of cloud stretching from N by W to S by E (ends not visible) passed over. The cloud line was composed of several layers of cumulus and stratus, and very great turbulence, producing vortical "streamers" in the front, was noticed. The base of the clouds was about

1,500 feet high and they extended upwards to a great height. No rain.
7h. 48m. Brief calm. The line of clouds had passed over and given place to a " leaden "-coloured sky.
7h. 50m. Wind SW, force 5. Barometer commenced to rise. Heavy rain commenced.
8h. Thunder and lightning at intervals, continuing till about 10h.
8h. 15m. Dry bulb 56°F., wet bulb 55°F. Wind WSW, force 2. Heavy rain.
8h. 45m. Wind WSW, force 1. Steady rain.
9h. 30m. Slight rain. Wind S., force 2.
11h. Rain ceased. Light airs. Overcast.

CLEEVE E. CLOWSER.

The Meteorological Office Exhibit at Wembley

THE British Empire Exhibition at Wembley was opened by H.M. the King, on April 23rd, with all the pomp and ceremony befitting such an occasion. Unfortunately, the brilliance of the spectacle was somewhat marred by the gloominess of the weather, the sun being obscured by low cloud during the whole ceremony.

The apparent preparedness of the greater part of the Exhibition on the morning of the 23rd was a surprise to those who had visited the grounds only a few days previously. Gardens and trees seemed to have grown up in the night as if by magic, more especially so in the vicinity of H.M. Government Pavilion. In the less conspicuous parts of the grounds, however, there was still much to be done and the annexe to the Government Pavilion in which, according to the official guide, the meteorological exhibit was said to be housed, was still in a state of incompleteness. For reasons over which the Meteorological Office had no control, three weeks elapsed before this part of the building was opened to the public. The entrance to the meteorological section is to be found at the back of the Government Pavilion. It is self-contained, and the walls are hung with specially prepared diagrams illustrating the work of the Office with regard to Weather Forecasting, Climatology, Marine Meteorology, Upper Air Investigations and British Rainfall. Numerous instruments used in meteorological work are on view, amongst these being a Dines Pressure Tube Anemograph, which gives a continuous record of the speed and direction of the wind over the building. There is also an Autographic Rain Gauge to show the intensity of rainfall. In a glass bell is exhibited a specimen of a Balloon Meteorograph, together with a large working model of the same

instrument. [So reliable is this instrument in use that in spite of its small size, it can record temperature without an error of more than one degree centigrade, and pressure to within a few millimetres of mercury. The record is inscribed on a small piece of silvered plate about the size of a postage stamp and has to be deciphered by the aid of a microscope].

The preparation of forecasts is demonstrated by members of the Meteorological Office Staff who are on duty there. By means of a wireless installation, data from a great part of the Northern Hemisphere are collected. These are plotted on weather maps and deductions are drawn regarding the coming weather. Two large weather charts, each measuring 10 feet by 9 feet are to be seen in the main building near the front entrance, one of the western part of Europe and the other of a large part of the Northern Hemisphere extending from America to Russia. The chart for western Europe is drawn twice daily, for 7h. and for 13h., and that for the Northern Hemisphere once daily, so that visitors may see the current meteorological situation and at the same time realise the rapidity with which meteorological data are collected from very wide areas.

On May 14th, Their Majesties the King and Queen, accompanied by Their Majesties the King and Queen of Roumania, honoured the Meteorological Section with a visit. The Royal Party were received by Dr. G. C. Simpson, C.B.E., F.R.S., Director of the Meteorological Office, and inspected the exhibit with much interest. The King was particularly interested in the current weather map and in the meteorological log which was kept on board H.M.S. "Thrush," when His Majesty, as Prince George, was in command of that vessel. His Majesty immediately recalled the name of the officer who was responsible for the entries.

Judging from the interest shown by the numerous visitors who inspect the exhibit it would appear that the importance of meteorology is being increasingly recognised by the general public.

Like a Thief in the Night

On April 14th a cow was found dead at Shenfield Place, near Brentwood, Essex, and a post-mortem examination by a veterinary surgeon showed that the death was caused by lightning. A policeman on duty in Brentwood, a mile away, reported that it rained heavily between 3 a.m. and 3.30 and that he heard rumblings which sounded like thunder, but there is no other evidence for the thunderstorm, which must have been very local and very brief. We have to thank Mr. H. P. Landon for these details.

Weather Conditions in the Polar Regions and Amundsen's Polar Flight

IN the *Tidens Tegn* for March 1st, 1924, there was an account of the weather conditions in the north polar region, written by Dr. Hesselberg in view of Amundsen's proposed polar flight. Much valuable information is available from Jan Mayen Island, Bear Island and Spitsbergen, where Norway has permanent meteorological stations, and observations on other islands have been made by the different expeditions to the Arctic; those taken of the *Fram* expedition (1894-1896) form the most complete series and have been used for this article.

Dr. Hesselberg points out that the maximum wind velocity recorded on the Fram during any of the months, May, June and July was 15·5 m/s and that therefore the wind conditions do not constitute more of a hindrance than those in our own latitudes. Over the polar seas temperature rises rapidly during May. In June and July the temperature varies but slightly from the freezing point, and it is only the presence of ice which prevents it from rising still higher. Fog, however, is prevalent in the polar regions in the summer and it is this factor, and neither the cold nor the wind, which makes flying so difficult. The fog lies rather low so that there is no difficulty in flying above it, but a forced landing in a sea of fog might easily have fatal consequences. During the winter when the temperature and wind conditions make flying practically impossible there is little or no fog, but it makes its appearance in May and increases in frequency until the middle of July. The longest consecutive periods during which the *Fram* was surrounded with fog were 12 hours in May, 46 hours in June and 71 hours in July.

It is therefore very necessary that Amundsen should make his start as early in the year as possible and that the best measures should be taken to insure him as far as possible from running into unfavourable weather conditions which may occur even at the most favourable period of the year. Weather reports from as many stations as possible within the Arctic circle, from the Norwegian stations at Jan Mayen, Bear Island, Spitzbergen and Vardo, from Nome (Alaska) and from certain stations on the Russian and Siberian Arctic coast, will be sent to him. Dr. Hesselberg considers that reliance should not be placed on reports from the *Maud*, as there is some doubt as to the capabilities of her wireless outfit.

In justification of such a flight he points out that the weather conditions in the Polar regions have a great influence over the weather of the rest of the globe. A single flight will not provide information of great value, but it will open the way for a regular service of meteorological observations.

The Air-Waves from the Explosions at La Courtine

THE explosions arranged at La Courtine in Central France for May 15th, May 23rd and May 25th were carried out according to programme. On the first occasion conditions were very favourable in England as there was hardly any wind. A certain number of observers sent reports to the Meteorological Office to the effect that they had heard noises near the appropriate times but it is doubtful whether any of these can be attributed to the explosion. The sound-ranging stations obtained negative results. On the other hand, Mr. A. Edwards, observing at the Beckton Office of the Gas, Light and Coke Company with a micro-baroscope (made by fitting a T-piece in the mouth of a thermos flask and inserting a drop of oil in one branch) found evidence of air waves at 7.48 p.m. and 8.11 p.m. summer time. The explosion occurred at 7.30 p.m.

On May 23rd and also on May 25th the weather was rough. On May 23rd Mr. Edwards was again the most successful observer recording air waves at 8.32 p.m. and 8.39 p.m. (the explosion being timed for 8.0 p.m.). On the 25th Mr. J. J. Darling, working at University College, Dublin, with a hot wire anemometer obtained an indication of the third explosion at 9.58 a.m. If this observation is valid the air wave must have persisted for no less than 58 minutes.

It is of interest to note that Mr. H. Deslandres reports* that at Meudon, near Paris, not one of the three explosions was audible but that on the first two occasions trains of waves were recorded by a microphone arrangement. Wind interfered with observations on the 25th.

International Meetings

THE Report of the International Meteorological Conference of Directors and of the Meeting of the International Meteorological Committee at Utrecht, September, 1923, has been issued as publication No. 112 of the Koninklijk Nederlandsch Meteorologisch Instituut. The proceedings of the Conference were fully described in the *Meteorological Magazine* for October, 1923. We may note here that amongst the Appendices to the full Report are to be found some short papers of general interest. Appendix H contains the preliminary report on the audibility of the Oldebroek explosion, Appendix L an instructive discussion of reduction of pressure to sea level (it being shown that for a high station in Norway the rule hitherto recommended by international convention serves well enough in summer but that in winter it does not give consistent results). Appendix O, con-

* *Comptes Rendus.* Tome 178. May 26th and June 2nd, 1924.

tributed by Professor Exner, is concerned with the correlation of weather anomalies in different parts of the world, and includes a map showing for December to what extent pressure in other regions is correlated with that in Iceland.

Observatory Reports for 1923

FROM Falmouth Observatory we have received the Meteorological Notes and Tables for the year 1923. Full use has been made of the old records of the Observatory in the interesting comparisons between 1923 and earlier years.

The meteorological observations made at the Radcliffe Observatory, Oxford, during 1923, have also been published. Attention may be called to the fact that Oxford is the only place in the Home Counties for which the daily observations are published so promptly in a single report.* Anyone who wants to know the weather of a year ago, say on June 17th, 1923, can look it up for Oxford—9 hours of sunshine and light winds from the north.

The uninitiated may be puzzled by the temperatures that are published. On page 47 the maximum "shade" temperature for June is given as 75·8 on the 29th; on page 59, the temperature "highest in air" is said to have been 74·4 at 17h. 30m. on the same day. We understand that 75·8 was the reading of a maximum thermometer in the Stevenson screen, 74·4 the reading from the photo-thermogram which gives the temperature in a screen on the north or shady side of the stone building. May we express the hope that the distinction will be indicated in future in every monthly table?

Sunlight and Health

A MEETING was held at Carnegie House Hall, London, on Wednesday, May 14th, 1924, to inaugurate The Sunlight League. It is understood that the idea and the name are both due to Miss May Scanlan. The objects of the League are "To form and direct public opinion as to the value of Sunlight for life and health and the prevention and treatment of disease, and to support and co-operate with all existing agencies such as Health Societies, Schools, etc., that approve of this object." The League has for Presidents the Duke of Sutherland and Dr. Theobald A. Palm whilst Dr. C. W. Saleeby acts as Chairman of Council. The offices are at 20, Park Crescent, W. 1. Some instructive pamphlets by Dr. Saleeby have been issued already.

*The Greenwich observations for the twelve months ending with October, 1923, are printed in Whittaker's Almanac for 1924.

The Advisory Committee on Atmospheric Pollution

THE ninth report of the Advisory Committee on Atmospheric Pollution has recently been published. In addition to statistics covering the year ending March 31st, 1923, the report contains accounts of various interesting investigations. One curious fact may be picked out as significant and easy to remember. A comparison between the records obtained with the automatic filter and with the jet dust counter shows that the total amount of dust in the air is proportional to the number of individual particles, 10,000 particles per cubic centimetre yielding 1 milligramme per cubic metre, so that the average mass of a dust particle is 10^{-13} gramme and moreover this average persists whether the particles be many or few. The conclusion is probably sound, but it must be remembered that the weight is not determined directly, all we have to go on is the shade of the deposit on the paper of the automatic filter. The report shows that a good start has been made in the direct attack on the determination of the relation between visibility and the amount of dust in the air. Special apparatus has had to be designed so as to make the specification of the loss of light in a particular observation as straightforward as possible and so facilitate numerical comparisons. The Report is to be obtained from H.M. Stationery Office, Imperial House, Kingsway, London, W.C. 2. Price 4s. 6d. Net.

Records of Atmospheric Pollution

ARRANGEMENTS have been made by the Advisory Committee on Atmospheric Pollution for the circulation, month by month, of abstracts of the records from deposit gauges in anticipation of the full tables published in the Annual Report of the Committee. The statement for April shows some remarkable variations. In the centre of Liverpool the deposit amounted to 34 grammes per square metre (say an ounce per square yard), whereas on the outskirts of Southport the deposit was only 2 grammes per square metre. In the City of London it was $13\frac{1}{2}$ grammes per square metre. Copies of the Abstracts may be obtained from the Secretary of the Atmospheric Pollution Committee, 47, Victoria Street, S.W. 1.

News in Brief

THE Radcliffe Trustees have appointed Mr. Harold Knox Shaw (of Trinity College, Cambridge, Director of the Observatory at Helwan, Egypt) to be Radcliffe Observer, as successor to the late Dr. A. A. Rambaut. Mr. Shaw regards himself mainly as an astronomer but he has made valuable contributions to meteorology notably in connection with the study of Solar Radiation.

Since June 1st telegraphic reports have been received by the Meteorological Office of observations made at Harrogate at the hours appropriate for the maps of the Daily Weather Report. Hitherto inland information from the north of England has hardly been adequate for the needs of the Forecast Service. Responsibility for the observations at Harrogate has been accepted by the Corporation, who have maintained a climatological station for many years.

The meeting of the British Association for the Advancement of Science will be held this year at Toronto, August 6th—13th. Arrangements have been made for a number of papers, by both American and British meteorologists.

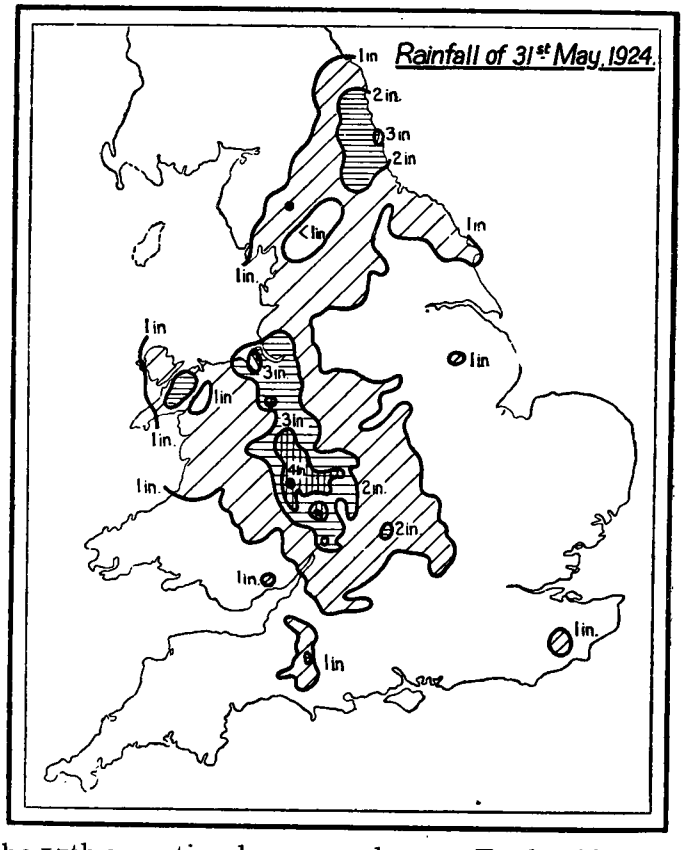
The report of the Conference held at Birkbeck College on January 3rd, 1924, between the Royal Meteorological Society, the Geographical Association and the Science Masters' Association has been published this month by Messrs. G. Philip & Sons, 32, Fleet Street, London, E.C. 4. Price 1s. 6d. net.

At the beginning of the year 1924, considerable changes were made in the Austrian Daily Weather Report. The most striking of the new features are maps showing the distribution of cloud, temperature and wind over Austria, on the comparatively large scale of 60 miles to the inch, and the distribution of pressure over Europe, the Atlantic and North America on a small scale. To judge by the reports for March, enough information is available to complete the latter map about every other day.

The Weather of May, 1924

THE most noteworthy features of the month were the repeated heavy falls of rain and the frequent occurrence of thunder. At the beginning of the month a belt of low pressure extended across the British Isles, but on the 3rd a northerly wind current began to spread south from the Arctic Ocean and thunderstorms with heavy rain were experienced in southern England. At a few places, notably Bristol and Stansted, Essex, the storms of May 3rd, though of short duration, were of great severity. Temperature fell appreciably on the 4th and for some days maxima remained well below 60°F. in England while snow or sleet fell in parts of northern England and Scotland. Shade temperatures below 32°F. were recorded at a few places in Scotland and Ireland and ground frosts occurred in many parts of the country, the exposed thermometer at Renfrew on the 9th reading as low as 18°F. From the 5th to the 16th sunny and rainy periods alternated owing to the repeated passage of depressions and secondaries from the Atlantic across the British Isles. Thunderstorms occurred in London and neighbouring counties in the early hours

of the 14th but during the day conditions improved and for the first time in the month temperature exceeded 70°F. locally; 78°F. was registered at Norwich and at Sheerness. After this until the end of the month night temperatures were generally well above the average for the time of year, but day temperatures were very unequal; 75°F. was, however, again exceeded on the 19th, 28th and 29th.



On the 17th an anticyclone passed across England but unsettled conditions were renewed subsequently. Thunderstorms were general in southern England and the Midlands on the 18th, 19th and 20th. Those which occurred on the 19th and 20th were accompanied in some cases by sudden short heavy falls of rain which caused considerable flooding and damage to crops in Bedfordshire, Hertfordshire, Buckinghamshire, Essex and Suffolk. In the latter county lightning also caused much damage to property. At Berkhampsted 34 mm. (1·34 ins.) fell in 35 mins. Mr. T. S. Wheater, the observer, writes that " About 5 p.m. heavy clouds seemed to come from both west and north-east and at 5.20 there was violent rain, thunder and lightning

with hail lasting till 5.55. Not more than ·04 ins. fell before 5.20. At 5.55 I measured 1·39 ins. and at 10 a.m. on the 20th the total for 24 hours was 1·41 ins. The hail was about the size of marbles. It broke the glass of garden frames and cut through rhubarb leaves and pitted the fairways of the golf course. Some of the hailstones had the appearance of an elongated acid drop with an extra marble shaped stone attached. I measured the length—three-quarters of an inch. These cottage loaf specimens were lying amongst the marble-shaped hailstones. Thunder was heard from 2.30 till about 6 p.m.: our particular storm lasted from 5.15 till 6." At Stroud 36 mm. (1·43 ins.) fell between noon and 6 p.m. and at Cheltenham 35 mm. (1·37 ins.) between 4 and 5. On the 20th the heaviest falls were reported from Woburn (Bedfordshire) and Benson, 27 mm. (1·06 ins.) being recorded in 20 mins. and 18 mins. respectively.

From the 20th to the end of the month the weather continued unsettled, the most noteworthy disturbances occurring on the 29th and 31st. On the former date a line squall swept across southern England accompanied by widespread thunderstorms and darkness and on the later date the passage of a depression over England was marked by the heaviest rainfall of the month.

The map (p. 118) giving the rainfall during the 24 hours from 10 a.m. on Saturday, May 31st, shows that the principal area with more than an inch of rain up to that time reached from Bristol and London to the Irish Sea and was connected through Westmoreland with the north-east coast, whilst falls exceeding 3 ins. occurred between Shrewsbury and Great Malvern, on the Wirral and round Sunderland and Tynemouth. Floods occurred in Worcestershire, Shropshire, Herefordshire and round Sunderland. Rain began in the early hours of Saturday in Sunderland and continued for about 36 hours. It came from the north-east mainly and was accompanied by a strong wind. In the western Midlands the rain did not commence until Saturday evening and most of the fall was over before 9h. the following morning. The most remarkable fall occurred at Humber Rectory, Leominster, where 76 mm. (3 ins.) out of a total amount of 95 mm. (3·75 ins.) were experienced in 1¾ hours. At Durham the amount for the 31st 70 mm. (2·76 ins.) has only been exceeded there once (on November 13th, 1901) in 83 years. The biggest fall in the 24 hours reported by any regular observer for the Meteorological Office, however, occurred at Ludlow, 123 mm., and an account of that storm will be found on p. 106.

These heavy falls brought the totals for the month far beyond the average. At Seathwaite the total was over 400 mm. (16 ins.) at Talymaer (Brecon) over 250 mm. (10 ins.), and at Cheltenham, Blundellsands (Lancaster) and Ross-on-Wye the totals 179 mm., 140 mm. and 123 mm. were the largest May rainfalls at these places since 1866, 1876 and 1886 respectively.

Rainfall: May, 1924: England and Wales.

CO.	STATION.	In.	mm.	Per-cent. of Av	CO.	STATION.	In.	mm.	Per-cent. of Av.
Lond.	Camden Square.....	3·14	80	178	*War.*	Birminghm, Edgbaston	4·95	126	231
Sur .	Reigate, Hartswood...	3·64	93	214	*Leics*	Leicester Town Hall...	3·69	94	...
Kent.	Tenterden, View Tower	5·54	141	353	,, .	Belvoir Castle.....	3·58	91	170
,, .	Folkestone, Boro. San.	2·64	67	...	*Rut .*	Ridlington.....	3·23	82	...
,, .	Broadstairs	3·10	79	187	*Linc.*	Boston, Skirbeck	2·93	74	166
,, .	Sevenoaks, Speldhurst.	3·45	88	...	,, .	Lincoln, Sessions House	2·30	58	123
Sus .	Patching Farm.....	3·91	99	211	,, .	Skegness, Estate Office.	2·66	67	156
,, .	Eastbourne, Wilm. Sq.	2·83	72	170	,, .	Louth, Westgate	2·50	63	123
,, .	Tottingworth Park....	4·93	125	274	,, .	Brigg	2·64	67	141
Hants	Totland Bay, Aston...	3·34	85	193	*Notts.*	Worksop, Hodsock....	2·43	62	122
,, .	Fordingbridge, Oaklnds	4·57	116	220	*Derby*	Mickleover, Clyde Ho..	3·80	97	193
,, .	Portsmouth, Vic. Park.	2·92	74	174	,, .	Buxton, Devon. Hos...	5·29	134	171
,, .	Ovington Rectory	4·37	111	201	*Ches.*	Runcorn, Weston Pt...	5·80	147	251
,, .	Grayshott	4·88	124	227	,, ..	Nantwich, Dorfold Hall	5·38	137	...
Berks	Wellington College...	4·11	104	221	*Lancs*	Bolton, Queen's Park .	5·75	146	...
,, .	Newbury, Greenham..	4·82	122	256	,, ..	Stonyhurst College....	6·80	173	239
Herts.	Bennington House....	·			,, ..	Southport, Hesketh...	5·22	133	250
Bucks	High Wycombe	3·86	98	219	,, ..	Lancaster, Strathspey.	6·49	165	...
Oxf..	Oxford, Mag. College..	4·30	109	240	*Yorks*	Sedbergh, Akay	9·23	234	288
Nor .	Pitsford, Sedgebrook..	3·95	100	207	,, .	Wath-upon-Dearne ...	3·01	77	148
,, .	Eye, Northolm.....	3·50	89	...	,, .	Bradford, Lister Pk...	4·65	118	222
Beds.	Woburn, Crawley Mill.	·			,, .	Oughtershaw Hall	8·45	215	...
Cam.	Cambridge, Bot. Gdns.	3·75	95	213	,, .	Wetherby, Ribston H..	4·74	120	229
Essex	Chelmsford, CountyLab	4·49	114	...	,, .	Hull, Pearson Park ...	3·07	78	159
,, .	Lexden, Hill House...	3·56	90	...	,, .	Holme-on-Spalding ...	3·68	93	...
Suff .	Hawkedon Rectory ...	4·50	114	243	,, .	Lowthorpe, The Elms.	3·17	81	163
,, .	Haughley House.....	3·96	101	...	,, .	West Witton, Ivy Ho..	5·64	143	...
Norf.	Beccles, Geldeston....	4·15	105	234	,, .	Pickering, Hungate ...	4·13	105	...
,, .	Norwich, Eaton	3·85	98	199	,, .	Middlesbrough	3·82	97	199
,, .	Blakeney	3·60	91	228	,, .	Baldersdale, Hury Res.	...	...	...
,, .	Swaffham	2·59	66	148	*Durh.*	Ushaw College	6·40	163	296
Wilts.	Devizes, Highclere....	5·24	133	289	*Nor .*	Newcastle, Town Moor.	7·07	180	348
Dor .	Evershot, Melbury Ho.	6·77	172	332	,, .	Bellingham Manor....	3·95	100	...
,, .	Weymouth, Westham..	4·21	107	260	,, .	Lilburn Tower Gdns...	4·68	119	...
,, .	Shaftesbury, Abbey Ho.	4·11	104	195	*Cumb*	Penrith, Newton Rigg..	...	...	...
Devon	Plymouth, The Hoe...	4·60	117	223	,, .	Carlisle, Scaleby Hall .	3·76	95	157
,, .	Polapit Tamar	3·15	80	156	,, .	Seathwaite	10·12	257	137
,, .	Ashburton, Druid Ho..	6·92	176	258	*Glam.*	Cardiff, Ely P. Stn.....	4·38	111	175
,, .	Cullompton	4·18	106	194	,, .	Treherbert, Tynywaun	6·80	173	...
,, .	Sidmouth, Sidmount ..	4·37	111	223	*Carm*	Carmarthen Friary....	3·89	99	141
,, .	Filleigh, Castle Hill ...	5·18	132	...	,, .	Llanwrda, Dolaucothy.	6·61	168	196
,, .	Hartland Abbey.....	2·51	64	...	*Pemb*	Haverfordwest, Portf'd			
Corn.	Redruth, Trewirgie ...	3·45	87	149	*Card.*	Gogerddan.....	5·13	130	194
,, .	Penzance, Morrab Gdn.	2·47	63	112	,, .	Cardigan,County Sch. .	3·70	94	...
,, .	St. Austell, Trevarna..	4·49	114	185	*Brec .*	Crickhowell, Talymaes	10·00	254	...
Soms	Chewton Mendip	6·73	171	244	*Rad .*	Birm.W.W.Tyrmynydd	6·08	154	177
,, .	Street, Hind Hayes ...	4·02	102	...	*Mont.*	Lake Vyrnwy	8·14	207	258
Glos..	Clifton College	4·31	109	205	*Denb.*	Llangynhafal	4·11	104	...
,, .	Cirencester	7·01	178	330	*Mer .*	Dolgelly, Bryntirion..	6·55	166	198
Here .	Ross, County Obsy.	4·85	123	228	*Carn.*	Llandudno	4·38	111	230
,, .	Ledbury, Underdown.	6·01	153	294	,, .	Snowdon, L. Llydaw 9	18·37	467	...
Salop	Church Stretton.....	6·51	165	252	*Ang .*	Holyhead, Salt Island.	4·76	121	243
,, .	Shifnal, Hatton Grange	4·31	109	209	,, .	Lligwy	5·33	135	...
Staff.	Tean, The Heath Ho...	4·07	103	189	*Isle of Man*				
Worc.	Ombersley, Holt Lock.	5·82	148	284		Douglas, Boro' Cem...	5·11	130	202
,, .	Blockley, Upton Wold.	7·20	183	335	*Guernsey*				
War.	Farnborough.....	6·15	156	274		St. Peter Port Grange .	2·88	73	169

Rainfall: May, 1924: Scotland and Ireland

CO.	STATION	In.	mm.	Per-cent. of Av.	CO.	STATION.	In.	mm.	Per-cent of Av.
Wigt.	Stoneykirk, Ardwell Ho	3·31	84	132	*Suth.*	Melvich School	2·36	60	115
,, .	Pt. William, Monreith .	3·31	84	...	*Caith*	Loch More, Achfary	3·60	91	82
Kirk.	Carsphairn, Shiel.	4·99	127	...	,, ..	Wick	2·30	58	111
,, .	Dumfries, Cargen	4·68	119	155	*Ork .*	Pomona, Deerness	1·96	50	98
Dum	Drumlanrig	4·45	113	170	*Shet .*	Lerwick	3·32	84	159
Roxb	Branxholme	3·61	92	160	*Cork.*	Caheragh Rectory	3·54	90	...
Selk .	Ettrick Manse	5·79	147	...	,, ..	Dunmanway Rectory.	3·64	93	107
Berk.	Marchmont House	5·44	138	220	,, ..	Ballinacurra	3·50	89	148
Hadd	North Berwick Res.	4·46	113	224	,, ..	Glanmire, Lota Lo.	3·89	99	159
Midl	Edinburgh, Roy. Obs. .	4·46	113	255	*Kerry*	Valencia Obsy.	3·59	91	113
Lan .	Biggar	3·25	83	162	,, .	Gearahameen	6·10	155	...
Ayr .	Kilmarnock, Agric. C. .	4·64	118	201	,, .	Killarney Asylum	3·90	99	127
,, .	Girvan, Pinmore	3·45	88	116	,, .	Darrynane Abbey	...	...	...
Renf.	Glasgow, Queen's Pk. .	4·00	102	164	*Wat .*	Waterford, Brook Lo. .	2·82	72	122
,, .	Greenock, Prospect H. .	5·12	130	148	*Tip .*	Nenagh, Cas. Lough	3·10	79	126
Bute.	Rothesay, Ardencraig.	4·67	119	154	,, .	Tipperary	4·58	116	...
,, .	Dougarie Lodge	5·31	135	...	,, .	Cashel, Ballinamona . .	3·61	92	150
Arg .	Glen Etive	...	...	...	*Lim .*	Foynes, Coolnanes	3·07	78	132
,, .	Oban	3·69	94	...	,, .	Castleconnell Rec.	5·05	128	...
,, .	Poltalloch	3·96	101	137	*Clare*	Inagh, Mount Callan . .	5·59	142	...
,, .	Inveraray Castle	4·27	109	109	,, .	Broadford, Hurdlest'n.	4·38	111	...
,, .	Islay, Eallabus	5·56	141	210	*Wexf*	Newtownbarry	3·90	99	...
,, .	Mull, Benmore	7·60	193	...	,, .	Gorey, Courtown Ho. . .	3·47	88	156
Kinr.	Loch Leven Sluice	4·78	121	196	*Kilk.*	Kilkenny Castle	3·19	81	144
Perth	Loch Dhu	7·15	182	159	*Wic .*	Rathnew, Clonmannon	3·38	86	...
,, ..	Balquhidder, Stronvar.	5·88	149	146	*Cars.*	Hacketstown Rectory .	3·99	101	153
,, ..	Crieff, Strathearn Hyd.	6·16	157	247	*QCo.* .	Blandsfort House	...	...	...
,, ..	Blair Castle Gardens . .	2·98	76	...	,,	Mountmellick	3·87	98	...
,, .	Coupar Angus School . .	4·79	122	197	*KCo.*	Birr Castle	4·26	108	191
Forf.	Dundee, E. Necropolis.	4·40	112	211	*Dubl.*	Dublin, FitzWm. Sq. . .	2·55	65	124
,, .	Pearsie House	6·13	156	...	,, .	Balbriggan, Ardgillan .	3·19	81	153
,, .	Montrose, Sunnyside . .	3·77	96	185	*Me'th*	Drogheda, Mornington	2·60	66	...
Aber.	Braemar Bank	3·68	93	154	*W.M*	Mullingar, Belvedere .	3·66	93	149
,, .	Logie Coldstone Sch. . .	4·23	107	170	*Long*	Castle Forbes Gdns.	4·01	102	155
,, .	Aberdeen, Cranford Ho	5·93	151	239	*Gal .*	Galway, Waterdale	...	...	...
,, .	Fyvie Castle	5·11	130	...	,, .	Ballynahinch Castle . .	7·26	184	...
Mor .	Gordon Castle	3·51	89	166	*Mayo*	Mallaranny	7·51	191	...
,,	Grantown-on-Spey	3·27	83	140	,, .	Westport House	5·31	135	186
Na .	Nairn, Delnies	2·56	65	142	,, .	Delphi Lodge	8·60	218	...
Inv..	Ben Alder Lodge	3·74	95	...	*Sligo*	Markree Obsy.	5·83	148	213
,, .	Kingussie, The Birches	3·15	80	...	*Ferm*	Enniskillen, Portora . .	5·49	139	...
,, .	Fort Augustus	3·86	98	162	*Arm.*	Armagh Obsy.	4·09	104	172
,, .	Loch Quoich, Loan	5·00	127	...	*Down*	Warrenpoint	4·77	121	...
,, .	Glenquoich	...	...	...	,, .	Seaforde	5·01	127	190
,, .	Inverness, Culduthel R.	4·23	107	...	,, .	Donaghadee	3·58	91	158
,, .	Arisaig, Faire-na-Squir	3·35	85	...	,, .	Banbridge, Milltown .	3·93	100	175
,, .	Fort William	3·86	98	100	*Antr.*	Belfast, Cavehill Rd. . .	5·49	139	...
,, .	Skye, Dunvegan	4·03	102	...	,, .	Glenarm Castle	5·28	134	...
,, .	Barra, Castlebay	3·00	76	...	,, .	Ballymena, Harryville	6·15	156	215
R&C	Alness, Ardross Cas. . .	5·77	147	222	*Lon .*	Londonderry, Creggan	4·80	122	183
,, .	Ullapool	2·43	62	...	*Tyr .*	Donaghmore	5·47	139	...
,, .	Torridon, Bendamph. .	3·92	100	86	,, .	Omagh, Edenfel	5·92	150	229
,, .	L. Carron, Plockton . . .	2·26	57	...	*Don .*	Malin Head	3·72	94	188
,, .	Stornoway	3·06	78	120	,, .	Rathmullen	...	...	...
Suth.	Dunrobin Castle	...	...	...	,, .	Dunfanaghy	3·75	95	144
,, .	Lairg	2·29	58	...	,, .	Narin, Kiltoorish	5·47	139	...
,, .	Tongue Manse	3·13	79	131	,, .	Killybegs, Rockmount.	5·26	134	146

Climatological Table for the British Empire, December, 1923

STATIONS	PRESSURE		TEMPERATURE							Relative Humidity	Mean Cloud Am'nt	PRECIPITATION			BRIGHT SUNSHINE	
	Mean of Day M.S.L	Diff. from Normal	Absolute		Mean Values				Mean Wet Bulb			Am'nt	Diff. from Normal	Days	Hours per day	Percentage of possible
			Max.	Min.	Max.	Min.	½ max. and min.	Diff. from Normal								
	mb.	mb.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	%	0—10	mm.	mm.			
London, Kew Obsy.	1015·7	+ 2·0	51	25	45·0	33·3	39·1	— 1·2	39·1	87	7·2	52	— 6	18	1·1	15
Gibraltar	1023·3	+ 3·7	67	41	60·4	48·0	54·2	— 1·8	49·6	72	3·0	10	—130	4	...	...
Malta	1014·7	— 1·2	68	39	60·6	53·2	56·9	— 0·1	52·1	75	5·3	103	+ 17	21	5·1	53
Sierra Leone	1011·6	+ 0·4	92	73	89·7	75·6	82·7	+ 1·2	76·7	74	3·2	5	— 32	3	...	...
Lagos, Nigeria	1009·8	— 0·7	92	74	90·1	76·8	83·5	+ 2·2	78·6	75	5·7	0	— 21	0	...	...
Kaduna, Nigeria	1013·6	+ 0·8	94	...	90·5	...	...	...	61·4	40	1·9	0	— 3	0	...	...
Zomba, Nyasaland	1008·5	— 0·1	94	59	81·8	65·0	73·4	+ 0·7	...	92	7·9	342	+ 51	22	...	...
Salisbury, Rhodesia	1008·7	— 1·2	99	49	84·3	55·6	69·9	0·0	63·7	60	5·7	200	+ 54	18	...	...
Cape Town	1014·9	+ 0·6	88	51	78·7	60·8	69·7	+ 2·1	66·0	65	2·2	5	— 17	4	...	...
Johannesburg	1010·8	— 0·2	86	46	77·1	54·7	65·9	+ 0·8	55·8	62	4·7	59	— 64	10	8·0	59
Mauritius	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Bloemfontein	...	...	97	48	88·4	58·8	73·6	+ 1·8	60·3	46	2·4	5	— 57	3	...	...
Calcutta, Alipore Obsy.	1015·9	+ 0·2	83	49	78·5	57·2	67·9	+ 1·4	58·3	81	2·0	5	0	*1	...	...
Bombay	1012·1	— 1·2	90	65	86·0	71·1	78·5	+ 1·2	66·6	68	1·8	0	— 2	*0	...	...
Madras	1013·1	— 0·4	87	67	83·3	71·2	77·3	+ 0·8	71·9	82	6·9	65	— 93	*3	...	...
Colombo, Ceylon	1010·0	+ 0·2	92	69	85·6	72·4	79·0	— 0·7	75·3	73	7·0	229	+ 89	17	5·9	50
Hong Kong	1020·6	+ 0·7	80	48	68·8	60·6	64·7	+ 1·8	59·1	71	6·6	8	— 23	5	4·8	45
Sandakan	...	...	88	73	85·6	74·8	80·2	+ 0·1	†76·7	†81	...	542	+ 93	21	...	...
Sydney	1012·4	+ 0·5	98	58	79·8	64·2	72·0	+ 2·0	65·4	67	5·1	34	— 33	11	8·0	56
Melbourne	1012·5	0·0	100	48	74·5	56·1	65·3	+ 1·0	59·1	62	6·2	80	+ 21	13	...	...
Adelaide	1012·5	— 0·7	106	48	82·7	59·7	71·2	0·0	60·3	49	5·4	69	+ 45	10	7·9	55
Perth, W. Australia	1012·8	— 0·5	95	53	80·5	59·7	70·1	— 0·5	61·0	57	3·0	22	+ 7	4	10·1	72
Coolgardie	1010·8	— 0·4	100	49	88·3	59·2	73·7	— 2·1	63·7	41	3·6	12	— 6	6	...	...
Brisbane	1013·7	+ 1·8	96	66	85·8	70·7	78·3	+ 1·9	72·5	69	5·9	74	— 51	15	8·0	57
Hobart, Tasmania	1008·5	— 1·2	88	39	68·5	51·6	60·1	— 0·3	52·9	61	6·7	55	+ 5	13	7·4	49
Wellington, N.Z.	1015·2	+ 3·4	75	48	69·4	57·6	63·5	+ 3·0	58·1	70	6·4	46	— 36	11	7·0	46
Suva, Fiji	1010·7	+ 2·1	85	67	82·2	71·7	76·9	— 2·0	73·7	78	6·0	202	—106	16	...	...
Kingston, Jamaica	1014·8	+ 0·6	91	66	87·1	68·4	77·7	0·0	...	69	3·9	7	— 34	2	...	...
Grenada, W.I.	1013·5	+ 1·6	88	69	83·1	72·9	78·0	— 0·1	74·5	82	6·1	321	+133	22	...	...
Toronto	1015·8	— 1·6	53	18	41·3	31·0	36·1	+ 9·9	32·9	79	7·5	77	+ 5	13	1·7	19
Winnipeg	1015·1	— 2·8	44	—20	25·5	10·0	17·7	+12·0	16·0	59	3·7	7	— 17	4	3·6	44
St. John, N.B.	1014·3	+ 0·1	52	5	37·3	25·0	31·1	+ 6·7	29·3	81	7·6	153	+ 47	17	2·3	26
Victoria, B.C.	1016·3	— 0·5	55	17	45·0	38·0	41·5	0·0	39·6	90	8·2	108	— 42	21	1·7	20

* For Indian stations a rain day is a day on which 0·1 in. (2·5 mm.) or more rain has fallen. † Mean of observations at 9h., 15h., 21h., from April 1923.

Climatological Table for the British Empire for the Year 1923

STATIONS	PRESSURE		TEMPERATURE							Relative Humidity	Mean Cloud Am'nt	PRECIPITATION			BRIGHT SUNSHINE	
			Absolute		Mean Values				Mean							
	Mean of Day M.S.L.	Diff. from Normal	Max.	Min.	Max	Min.	½ max. and min.	Diff. from Normal	Wet Bulb.			Am'nt	Diff. from Normal	Days	Hours per day	Percentage of possible.
	mb.	mb.	° F.	° F.	° F.	° F.	° F.	° F.	° F.	%	0—10	mm.	mm.			
London, Kew Obsy.	1013·7	— 1·7	90	23	56·7	43·1	49·9	+ 0·2	47·0	79	6·8	637	+ 31	168	3·9	30
Gibraltar	1018·3	+ 1·8	95	41	69·6	57·0	63·3	— 0·8	58·1	74	4·2	687	—223	82	...	...
Malta	1015·6	+ 0·8	99	39	70·0	61·2	65·6	+ 0·4	60·2	75	4·3	466	+ 5	88	...	...
Sierra Leone	1012·0	+ 0·2	95	69	87·1	73·9	80·5	— 0·4	75·0	75	6·2	3184	—733	181	...	...
Lagos, Nigeria	1010·9	— 0·5	92	69	86·4	75·0	80·7	+ 0·5	76·8	77	7·4	1817	— 3	135	...	...
Kaduna, Nigeria	1013·5	+ 1·1	100	...	88·0	...	...	...	66·9	61	...	1106	—240	112	...	...
Zomba, Nyasaland	1012·0	— 0·1	100	46	80·2	61·1	70·6	+ 1·5	...	85	5·1	1201	—210	132	...	...
Salisbury, Rhodesia	1012·5	— 1·6	99	31	80·4	51·7	66·0	+ 0·7	58·6	62	3·4	995	+187	95	...	...
Cape Town	1016·6	— 0·4	100	37	71·3	54·5	62·9	+ 0·8	59·3	73	4·3	708	+ 60	105	...	...
Johannesburg	1015·7	— 0·3	89	28	71·5	50·5	61·0	+ 1·5	50·3	60	3·5	672	—128	83	8·7	73
Mauritius	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Bloemfontein	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Calcutta, Alipore Obsy.	1007·1	— 0·4	108	47	87·6	71·1	79·4	+ 0·7	71·5	81	5·4	1434	—134	*71	...	...
Bombay	1008·6	— 0·5	96	63	86·8	75·4	81·1	+ 0·6	72·9	76	4·4	1970	+144	*64	...	...
Madras	1008·4	— 0·4	110	63	91·9	75·5	83·7	+ 0·8	74·9	71	5·0	949	—306	*45	...	...
Colombo, Ceylon	1010·1	+ 0·7	93	65	86·6	74·4	80·5	— 0·7	76·9	71	7·1	2425	+269	226	7·0	58
Hong Kong	1012·1	— 0·5	93	46	77·1	69·0	73·0	+ 0·7	67·6	76	6·6	2711	+598	136	5·9	49
Sandakan	...	...	92	71	87·1	75·1	81·1	— 0·2	†76·6	†79	...	3548	+500	175	...	...
Sydney	1014·5	— 1·4	103	41	72·3	56·5	64·4	+ 1·4	57·6	65	4·6	939	—285	123	6·9	56
Melbourne	1014·1	— 2·2	106	34	67·1	50·0	58·6	+ 0·2	53·6	65	5·7	575	— 72	158	...	...
Adelaide	1015·3	— 1·8	108	38	73·3	53·9	63·6	+ 0·6	54·8	56	5·3	757	+225	139	6·8	55
Perth, W. Australia	1015·7	— 0·7	107	40	73·2	55·6	64·4	+ 0·4	57·7	65	4·8	1128	+274	134	6·9	56
Coolgardie	1014·9	— 1·1	110	31	77·9	52·7	65·3	+ 0·8	56·9	45	4·3	192	— 66	64	...	...
Brisbane	1014·8	— 0·9	99	41	78·9	60·3	69·6	+ 0·7	63·9	63	3·9	590	—567	91	8·5	71
Hobart, Tasmania	1010·0	— 2·6	88	34	61·5	46·7	54·1	— 0·2	48·9	67	6·5	836	+234	198	5·8	48
Wellington, N.Z.	1013·9	— 0·2	77	30	62·0	49·2	55·6	+ 0·2	...	73	6·4	1042	—190	164	5·3	44
Suva, Fiji	1011·1	— 0·3	91	57	81·1	70·4	75·7	— 1·3	72·7	83	6·6	2777	— 77	228	...	...
Kingston, Jamaica	1014·0	+ 0·1	98	63	88·8	71·1	79·9	+ 0·6	...	69	5·0	454	—407	62	...	...
Grenada, W.I.	1014·1	+ 1·7	90	67	84·0	73·5	78·7	0·0	73·8	74	5·0	1416	—511	232	...	...
Toronto	1016·5	+ 0·1	96	—12	54·1	37·1	45·6	+ 1·2	40·6	69	5·3	854	+ 4	154	...	...
Winnipeg	1016·1	— 0·1	96	—35	48·7	26·9	37·8	+ 3·5	33·4	...	3·6	400	—117	98	...	...
St. John, N.B.	1014·4	— 0·3	85	—15	47·2	31·9	39·6	— 1·6	36·5	...	6·1	1137	— 83	143	...	...
Victoria, B.C.	1017·4	+ 1·0	86	11	55·9	44·1	50·0	+ 0·5	46·4	84	5·6	626	—201	136	...	...

* For Indian stations a rain day is a day on which 0·1 in. (2·5 mm.) or more rain has fallen. † Corrected to mean of observations at 9h., 15h., 21h

THE floods reported from the Continent during April, continued during the early part of May. At Strasbourg a rise of 6 feet in 48 hours in the height of the Rhine was recorded; in Cologne, many houses were flooded and land was inundated. Summerlike weather prevailed over northern Italy until the 10th, when heavy rain and hail fell in various districts ruining many crops. Snow fell on the Treviso Alps and abnormally low temperatures were reported from Bergamo and Piaconza on the 12th. From the 10th to the 24th high temperatures were experienced generally over Central Europe. During this period violent thunderstorms were reported from many districts. On the 22nd a disastrous hailstorm was experienced in Upper Silesia: hailstones fell as large as walnuts, stripping the fruit trees of all their blossom and at the end of a quarter of an hour the hailstones were lying to a depth varying from one to six feet. Although people caught in the storm rushed for shelter, many were severely injured by the stones and thousands of birds lay dead in the fields. A feature of the storm was that, although it occurred between two and three in the afternoon, it was pitch dark at the time. Two hours after this catastrophe, the district was visited by a violent thunderstorm with torrential rain. Many people were killed by lightning, and railways, roads and bridges were carried away by the water.

From the United States comes the news of severe floods in Virginia and Maryland, the worst known for 50 years. The Ohio River at Pittsburgh rose 26 feet, or 4 feet above flood mark. At the end of the month, the Southern States were swept by wind storms, and many casualties occurred.

The high temperatures in the Arctic Ocean referred to in the article on *The Abnormal Weather of the Winter and Early Spring, 1923-24*, continued during May, the mean temperature at Spitsbergen being 29° F., or 7° above normal.

The special message from Brazil states that the rainfall over the country, with the exception of the Minas Geraes and Rio Gran do Sul States, was excessive, being 123 mm., 41 mm. and 67 mm. above normal in the northern, central and southern districts respectively. As in April numerous secondary depressions passed across the south of the country. At Rio de Janeiro both pressure and temperature were slightly above the normal for the month.

Rainfall May, 1924: General Distribution

England and Wales	214	per cent. of the average 1881-1915.
Scotland	161	
Ireland	159	
British Isles	189	

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Kelvin

JUNE 26TH, 1824—DECEMBER 23RD, 1907

By Sir NAPIER SHAW, F.R.S.

IN my undergraduate days, Kelvin was known to all students of mathematics in Cambridge as one of the authors of Thomson and Tait's "Natural Philosophy," vol. 1, the first (and last) instalment of a great work in four volumes (*absit omen*), which was to range from definitions and fundamental ideas to electrodynamics. Our volume got as far as elasticity. It differed from our text-books because it seemed to be guided by the wish to know things, not so much by the desire to arrange things that were known. You would not expect to find the explanation of a jamming drawer in our books on friction, but T. & T'. gave it. It used geometrical or analytical methods just as it liked. We used to see Kelvin frequently in Cambridge, but very seldom Tait. Kelvin was a Fellow of Peterhouse, and took an interest in the Musical Society, and he and Maxwell were busy about ohms and ampères and volts. In 1884 he provided Peterhouse with an installation of electric light, to be the first in Cambridge. But while it was in the making, my own College was celebrating a tercentenary, and had been redecorated; the Master, horrified at the idea of spoiling the new clean surfaces with gas, begged me, as Lecturer in Natural Science, to see about electricity. I got Edward Hopkinson of Mather & Platt's, then a junior Fellow, to set up an installation in the Chapel and Hall in time for the commemoration service and banquet. It was done with an

Wt 69—P 1 1000 7/24 M & C

agricultural engine and a dynamo (with a fault in it that had to be excised by cutting out one coil), a coal-porter as engineer, and the whole only finished on the day itself, no rehearsal. Then, to our dismay, Kelvin appeared in Cambridge, and had to be invited to see the experiment put through. We had arranged with the engineman that if the dynamo got overheated and he had to shut down, he should blow his whistle. In the middle of a speech by the American Ambassador, J. R. Lowell, off went the whistle. Hopkinson went to see about the shutting down, while, much humiliated, I arranged about lighting the gas. But, after all, it was only a *feu de joie* on the part of the lonely engineman : he was so much elated at having run for three hours without a stop that he could not help it, and I still cherish Kelvin's congratulations on the success of that evening's effort.

But it was at Section A of the British Association that young men got to know Kelvin personally. He was always there—Lady Kelvin always with him. We used then to go on with the reading of papers from 11 o'clock till 3 without intermission—sherry and biscuit by way of lunch taken in turn. We got through a good many papers, and Kelvin had a good word to say about each. You never knew what he would say or what he would talk about, but you always knew how he would say it—always with the most perfect good nature, always full of energy and lively interest. He once managed to get in an eloquent appeal for the use of the globes as an educational subject, though it was not the subject of the paper. He always carried a note-book, and was always making use of it. He was always self-possessed ; he had a slight limp as the result of a carriage accident, and I well recollect his limping across from his place to the press-reporter at the table to say: "Put this down," when he had something to say that he wanted the public to hear about. My recollections of his own papers are chiefly of the contents of his note-books on turbulent motion, but I shall never forget a demonstration of the phonograph when that was first produced at a meeting of the British Association. Kelvin was invited to speak into it, and with a good deal of preliminary arrangement of his vocal organs, for he was not an easy speaker, he did so. Then the cylinder was put on to speak, and Kelvin, addressing himself out of the phonograph, with all his imperfections in his throat, was almost drowned in irrepressible laughter.

Kelvin's association with meteorology, apart from thermodynamics, the absolute zero of temperature and its relation to the gas thermometer, and his brother James Thomson's Bakerian lecture, centres mainly in the electrical recorders at Kew Observatory and Greenwich Observatory and the Harmonic Analyser at the Office. Neither of them has contributed to our knowledge of the atmosphere all that was expected of it. The first, because

of the amazing apathy of the Universities of this country on the subject of atmospheric electricity, partly no doubt because the recorder goes out of control at the mere suggestion of a thunderstorm; and the harmonic analyser because, as a means of investigating the sequence of events in the atmosphere, it was misconceived. When I joined the Meteorological Council in 1897, harmonic analysis was the only surviving item of a large programme of research that had been mooted in 1878. Balloons had gone, cloud-photographs had gone, shell-bursts had gone, the daily map was routine, only harmonic analysis and a sort of "founder's share" in the observations at Fort William and Ben Nevis remained. Harmonic analysis, which was one of Kelvin's hobbies, had been tried on the daily curves and on the monthly means with not much result beyond the second order term which is now well known. But a strange result had happened. It was agreed that a single day could not be expected to show any real periodicities, so the tabulated observations were compiled into five-day means in order that they might become amenable to harmonic analysis. Sir Richard Strachey spent a great amount of personal labour over the inquiry, and regarded the third component of the diurnal range as epoch-making. I have no recollection of any work with the seasonal range beyond what I gave myself, with Sir Robert Waley Cohen, in a paper to the Royal Society in which daily values were used. I cannot but think that it was not any sort of real knowledge of what five-day hourly means contained that supplied the motive, so much as the existence of harmonic analysis as an implement and the desire to use it. It is one of many examples of meteorological activity being guided by the desire to use an implement rather than the exploration of the general problem. To get five days inextricably mixed up in order to understand what they are really doing is a kind of witchcraft that is hard to follow. It does not exhibit the real Kelvin in the same way as "Thomson and Tait," or the Thomson-compass, the deep sea-sounder or the syphon-recorder.

OFFICIAL NOTICE

To meet the needs of observers who communicate their rain-gauge readings monthly to local organisations, specially ruled postcards are now available. These postcards have been published by H.M. Stationery Office at the request of the Meteorological Office; they are designated Form 1098, and are to be purchased from H.M. Stationery Office, Kingsway, London, W.C. 2, the price being 12 copies 6d.; 144, 5s. net.

Royal Meteorological Society

THE monthly meeting of the Society was held on Wednesday, June 18th, at 49, Cromwell Road, South Kensington, Capt. C. J. P. Cave, President, in the Chair.

C. K. M. Douglas, B.A.—Further researches into the European upper air data, with special reference to the life history of cyclones.

The need for international co-operation in the study of the upper air was appreciated at a very early stage, and before the war the observations made in all European countries on selected days were published together. The material placed at the disposal of investigators in this way, though very limited, has proved of great value in several lines of research. It is to be hoped that the plans for the resumption of publication of such information will mature in the near future. Captain Douglas has selected from the international reports the few which illustrate the initial stages of the development of a cyclone. His work goes some way towards resuscitating the old idea that the air at the centre of a cyclone rises because it is warmer than its surroundings. Mr. W. H. Dines's researches showed that the air at the centre of the cyclone at moderate heights is colder than the average. According to Douglas it is just when there is a great stream of cool air passing across the country that an intruding tongue of warm air is likely to be a centre of convective movement. There is no meteorologist who visualises more clearly than Douglas the changing structure of atmospheric currents. Such intimate knowledge of individual cases provides the best check on theoretical researches.

L. F. Lewis, B.Sc.—The effect of the source of air on its temperature at 4,000 *feet and* 10,000 *feet.*

The study of the characteristics of the atmosphere by tracing the history of each parcel of air was introduced eighteen years ago in a famous memoir by Shaw and Lempfert—"The Life History of Surface Air Currents." The investigator notes that one weather map for a certain hour shows that the air at a particular place has been travelling for some time from the east with such and such a velocity, and, therefore, must have been near such and such a place 6 hours before; the previous weather map shows that the air at that place must have come from a certain direction, and so on. The method has been used frequently in recent years, and always yields valuable and convincing results.

Miss Lewis has discussed various cases in which the previous history of air which had reached the British Isles could be traced. Dealing in the first instance with air within 2,000 feet

of the surface, she found that in winter the dominant factor which determined whether the air was warm or cool, was whether it had recently been over the Atlantic or over the Continent. Going on to the case of higher strata (and we may note that the computation of the air-paths is more difficult in this case), she found that the land and sea effect diminished in importance and the latitude from which the air had come played the leading part. Very useful generalisations to keep in mind!

L. H. G. Dines, M.A.—A simple electrical time-marking system for use with self-recording meteorological instruments.

Accurate timing of meteorological occurrences is seldom attempted in this country. The time at which a seismic wave reaches an Observatory is determined to a second, but the time of passage of a line-squall can hardly be stated within two or three minutes. Of course, there is a reason. The seismologist is mainly interested in questions for which precise information as to time is essential: there are comparatively few cases in which it matters so much to know the exact time of a meteorological event, and, therefore, the open scale charts, which would be needed to show time within a few seconds, are not utilised. There is room for improvement, however, even with the small time-scale of the present charts, and Mr. Dines has done well to show how time marks can be made on the various instruments in a modern observatory. Much ingenuity was required to provide for the great range in the forces which had to be applied to the pen carriers of different instruments. The delicate float-barograph had to be merely stroked, whilst the robust pressure tube anemometer required a vigorous kick. The paper is quite properly confined to a description of the system introduced at Valencia Observatory. A comparison of other systems, such as those in use at Potsdam and Hong Kong, would be of interest.

Correspondence

To the Editor, *The Meteorological Magazine*

The Great Storm of May 31st, 1924,* Measurements in the Wirral Peninsula

THE following brief summary of the great rainfall and thunderstorm of May 31st to June 1st may be of interest. The total fall for 13 hours, 7 p.m. May 31st to 8 a.m. June 1st, was 3·31 inches, of which 1·23 inches fell between 7.5 p.m. and 8.15 p.m.

This heavy fall from 7.5 p.m. to 8.15 p.m. was accompanied

* For the general account of the storm see the *Meteorological Magazine*, June 1924, page 119.

by occasional thunder and lightning. There was a temporary lull in the rainfall until 8.30 p.m., when a severe thunderstorm broke over the district, accompanied by a continuous rainfall which lasted without interruption until 2 p.m. on Sunday afternoon, June 1st. The rain moderated in force considerably after 8 a.m., June 1st, and between that hour and 2 p.m. only 0·26 inch was measured. The total for the 24 hours ending 7 p.m. was 3·57 inches. This fall is of considerable interest owing to the fact that over a period of more than 60 years the previous highest record for this area was 2·03 inches. There was great flooding as the result.

It is also of interest to note that this fall brought our May total up to 6·00 inches against an average fall of 1·87 inches, which is far in excess of any other May reading recorded over a long period.

(Rev.) ERIC F. ROBSON.

St. Andrew's Vicarage, West Kirby, Cheshire, June 3rd, 1924.

A New Halo Phenomenon? An Oblique Arc 90° from the Sun

ON Tuesday, June 10th, at 10h. G.M.T., I observed here a small segment of a very large arc. I thought at first that it might be a belt of cirro-stratus cloud, but it was too clearly defined as a geometrical curve for such a supposition to be entertained. The arc consisted of a narrow white band, and was to the east of the sun, the difference in azimuth being nearly 90°.

The arc was oblique and slightly curved: if it had been prolonged it would have passed below the sun and about 45° from it, *i.e.*, 6° above the horizon, the elevation of which is 4°. Owing to the presence of much low nimbus and strato cumulus the phenomenon was visible only for about 30 seconds: the time was too short for angular measurements

T. H. APPLEGATE.

R.A.F. Station, Catlewater, Plymouth, June 27th, 1924.

Upper Air Research

IN accordance with the programme of the International Commission for the Upper Air, twelve registering balloons were sent up between March 3rd and March 22nd by the Upper Air Section of the Meteorological Office. Of the twelve, nine instruments were found and returned. Eight of the ascents were made from

the Aerodrome at Shotwick, near Chester, and the remainder from Kew Observatory. The percentage of finds was the same in each case.

Heights ranging up to 19·3 kms. were reached, the drift of the balloons being in all cases towards points between north-northeast and southeast. As has commonly been found heretofore, there was no appreciable connection between the height reached and the distance travelled. An ascent made from Kew on March 7th presented some interest from the fact that the balloon started in an easterly current, passed back at a higher level towards the south-east, and, after reaching 18 kms., fell some 40 miles to the east-southeast through the easterly current again.

As both stations are comparatively near the coast, the choice of the locality of the ascent on any given day is determined from the consideration of the pressure gradient prevailing a few hours beforehand. The system has worked well, and, in five months' working, 80 per cent. of the balloons sent up have been found and returned.

L. H. G. DINES.

Kew Observatory, Richmond, Surrey, June 12th, 1924.

Music and Meteorology

ALTHOUGH music is not first and foremost a descriptive art, yet certain passages echo the moods of Nature as they appeal to the composer, and appear to describe the meteorological aspect of things.

Among the classical composers, Handel included the "Hail-stone" Chorus in "Israel in Egypt." More famous is the thunderstorm in Beethoven's "Pastoral" Symphony, where "at least four different incidents faithfully portray not only the first drops of rain and the distant thunder, but all the feelings of depression and apprehension they inspire" (D. F. Tovey). Beethoven employs the piccolo in order to depict the whistling of the wind. This instrument is used for the same purpose by Wagner in "The Flying Dutchman." One of the finest storms in music is that depicted in the prelude to Wagner's "Valkyrie." The staccato scale played in the bass by the strings gives the dull monotony of the pouring rain, the other instruments join in as the storm rises to its climax with a long roll of thunder on the kettle-drums.

Both Chopin and Debussy have recorded their impressions of a rainy day in pianoforte music: the former in the "Raindrop" Prelude, the latter in "Un Jardin sous la Pluie." Debussy has likewise given us his ideas of anticyclonic weather in summer in that dreamy work "L'Apres-midi d'un Faune." Even the fiery

Wagner deserted his storms and tempests on occasion. In the "Valkyrie" prelude he depicted the storm tearing through the forest, but in the second act of "Siegfried" he represented, with the aid of the piccolo and violins in tremolo, the gentle breeze soughing in the trees on a fine afternoon.

CICELY M. BOTLEY.

10, *Wellington Road, Hastings, January 23rd*, 1924.

NOTES AND QUERIES

The Weather of October, 1923

A DETAILED examination of the weather in the British Isles during the four days, October 9th to 12th, 1923, has been undertaken at the Meteorological Office. Readers who have in their possession any autographic records of temperature, rainfall, humidity or wind (even if the records have already been submitted to the Office for any other purpose) are requested to lend them for a short time. Any details of the weather, such as the times at which rain began and ended, would also be welcome. Communications should be addressed to the Director, Meteorological Office, Air Ministry, W.C. 2, quoting the reference number 463722/23 (M.O.2.).

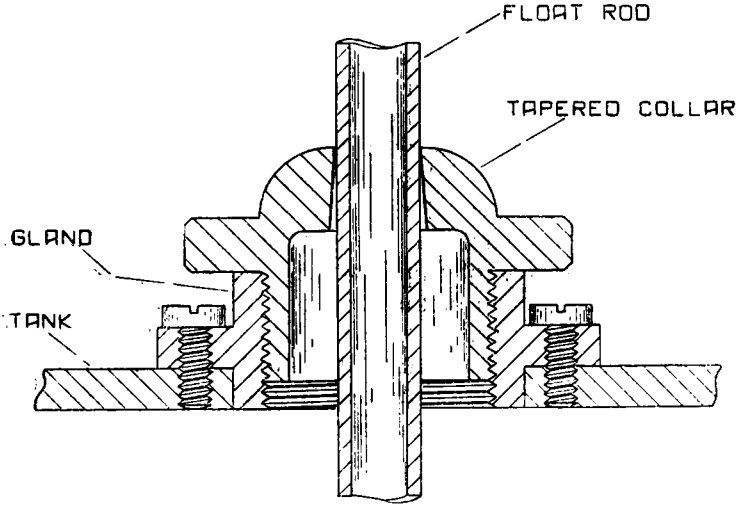
Defects of Pressure Tube Anemometer at Low Wind Speeds

THE up-and-down movement of the float in the Dines Tube Anemometer is controlled by means of a metal collar, screwed into the tank, through which the float spindle passes. The bore of the collar is cylindrical, and it follows that the bearing surface between the collar and the float spindle is considerable. Observers have frequently reported that the float rod "sticks," especially when the wind falls light during the night.

In order to investigate the cause of the "sticking," experiments have been carried out in the Instruments Division of the Meteorological Office during the past year. It was thought that the deposition of water drops on the float spindle and collar, which might conceivably occur at any time, but particularly at night, owing to condensation, would produce damping forces sufficient to resist the displacement of the float when the wind was light. The experiments confirmed this view, showing that the damping forces which developed when the collar and spindle were partially wetted were approximately five times the normal

frictional forces in the dry state. It was also found that the damping force depended on the size of the drops, being greater when the drops were smaller. Further, after the spindle and collar were completely wetted, the water was found to act as a lubricant, the float working more freely.

With a view to overcoming the defect, certain instruments have been provided with tapered collars, as illustrated below.



DINES ANEMOGRAPH: TAPERED COLLAR FOR FLOAT ROD GLAND.

The advantage of this type of collar is that the water runs off from the spindle into the float chamber. At the same time the area of communication between the inside and outside of the float chamber remains the same, and it is improbable that there is any increase in the leakage of air from the instrument. Reports from stations where these collars are in use indicate that the anemometer works properly in light winds.

A report received from one station suggested that the "sticking" of the float rod had been overcome by lubricating the collar and float rod by means of a small quantity of oil. On general principles such a procedure is not to be recommended, as, unless the parts were kept scrupulously clean and oiled frequently, there would be a tendency for dirt to accumulate on the rod, and the last state would be worse than the first.

The Gordon Bennett Race for free balloons which started for Brussels on Sunday, June 15th, 1924, was won by the Belgian, Lieut. Demuyter, who took advantage of an unexpected south wind and landed near Berwick, 438 miles from the starting point.

The India Weather Review

A CHANGE has been made in the system of publication of information with regard to the weather of India. The last issue of the *Monthly Weather Review* referred to December, 1920. The monthly summaries fos 1921 are all embodied in the *India Weather Review*, 1921, which has recently been published. It is to be noted that such information for the year 1921 as was immediately available was issued in the Annual Supplement to the *Indian Daily Weather Report* on January 11th, 1922. Opinions must differ as to the merits of monthly and annual publication of statistics. The advantage of finding all the figures for a particular station for the twelve months in a single volume is considerable, so that the change of practice will be welcomed by most climatologists.

An interesting feature of the new volume is the inclusion of a table showing for each of six stations the monthly means of direction and velocity of upper winds. The " tail-method " is used, and at one station or another heights such as 15 kilometres above sea level were reached in nearly every month of 1921.

Some criticisms of detail may be allowed. One is that there appears to be no reference in the Introduction or elsewhere to the standard of time to which the observations refer. According to the published instructions it is the rule to use local Mean Time at all the stations, even for the telegraphic service, but there may well have been a change of practice in the last twenty years. In a network covering such a wide range of longitude, this detail is important. Secondly, there is no information as to the latitude and longitude of the stations. The heights of stations provided with barometers are to be found (with some difficulty), but for other places (such as Cooch Behar, with 257 inches of rain in the year) this detail is missing. The other criticism is that there are two tables, Table B and Table C, both " Abstracts of 8 hrs. observations." Table B includes stations with barometers, Table C those without. Seven of the stations in Assam are in the former table, and eleven in the latter. It would be more convenient to the reader unfamiliar with local circumstances if these tables could be combined.

A Smoke Abatement Bill

A BILL " to amend the laws relating to Smoke Nuisances and for other purposes connected therewith " has been introduced in the House of Lords by the Earl de la Warr on behalf of the Government.

The effect of the measure will be to increase the penalties for the production of smoke in such quantities as to constitute a nuisance.

Weather Reports from Northeast Greenland

WE have had occasion previously to call attention to the enterprise shown by the Scandinavians in obtaining meteorological information from the neighbourhood of Greenland. At the end of June a Danish ship, the "Godthaab," started from Thorshavn to visit the settlements in northeast Greenland. The "Godthaab" is to keep in communication with Jan Mayen by wireless telegraphy, and meteorological reports are being transmitted via Tromsoe, the Norwegian meteorological service co-operating thereby with the Danish.

A number of reports from the "Godthaab" have already been received in the Forecast Division of the Meteorological Office from the area off northeast Greenland in about latitude 75° N. They form a valuable addition to the daily weather charts, extending them into the region of the Arctic north of the island of Jan Mayen (70° 59′ N, 8° 19′ W) and southwest of Spitzbergen, from which places weather reports are regularly received. The reports from the "Godthaab" on July 8th showed continuous thick fog, with a temperature little above the freezing point.

Thirteen Months in the Year

THE following resolution was adopted by the American Meteorological Society at the meeting held at the Weather Bureau, Washington, on April 30th, 1924:—

> . . . . "The American Meteorological Society recognizes the advantages and universal benefits to mankind throughout the world of a simplification of the calendar, and considers that the interest of the public and many branches of science dealing with statistical data, like meteorology and particularly climatology, will be promoted by the adoption of a thirteen-month calendar, permitting the summarizing of data in equal aliquot intervals of weeks, fortnights, months and seasons. It is opposed to any modification of the calendar, such for example, as has been proposed by the French, that retains the present incommensurate relations of the week and the months." . . . .

The Secretary was directed to transmit a copy of the resolution to the Committee of the League of Nations that is considering the reform of the calendar.

Most meteorologists on this side of the Atlantic will agree with Professor Marvin's sentiment: "I think we ought to oppose any change in our present calendar that would make our present data discontinuous with our future data and offer no real advantages." How Professor Marvin reconciled this dictum with his support for the resolution is not explained in the official report of the meeting.

Excessive Rainfall in Sicily in November, 1920

AN account of the rainfall in eastern Sicily in November, 1920, has been published recently by Senor Filippo Eredia*. It is remarkable in that at many stations the rainfall was not merely unprecedented but more than twice as much as had been recorded previously in November. In two cases more than the normal rainfall of the whole year. The rainfall was associated with the slow passage of depressions along the Mediterranean to the south of Sicily. Some of the more striking figures are quoted in the following table :—

STATION	Height Metres	NORMAL		Previous Max. in November mm.	NOVEMBER, 1920	
		Year mm.	November mm.		Rainfall mm.	Multiple of Normal
Viagrande‡ ..	405	1151·8	168·6	541·4	1090·4	6·5
Sant' Alfio‡ ..	550	1369·1	223·7	773·3	1051·0	4·7
Acireale	200	916·4	163·5	350·9	1042·3	6·4
Lentini	§	620·1	89·3	231·7	589·9	6·6
Linguaglossa ..	560	1226·9	116·6	439·0	894·0	7·7
Ramacca.. ..	500	548·7	66·4	346·0	530·5	8·0

In the British Isles the ratio of a month's rainfall to the normal has not been known† to exceed 4·7.

Siccawei Observatory

A VERY interesting account of the history and work of the Siccawei (Zi-ka-wei) Observatory for the past 50 years is contained in an illustrated supplement to the " North China Daily News," dated December 15th, 1923. The story of the growth of the Observatory begins in 1842 when Fr. Gotteland, a professor of Physics in Switzerland, landed at Shanghai and commenced regular astronomical observations ; his successors include such scientists as Henri le Lee, Decheverens, Chevalier, de Moidrey and Fr. Froc, the present director. An important event in the history of the meteorological department, instituted

* Le pioggie eccezionali sul versante orientale della Sicilia by Filippo Eredia. *Reale Accademia Nazionale Lei Lincei*, Vol. XXXII. Feb. 4th, 1923.

‡ Mr. Etria.

§ The height of Lentini is between 0 and 100 metres.

† Fluctuations of Monthly Rainfall, by J. Glasspoole, *British Rainfall* 1922, p. 238.

half a century ago, was the publication by Decheverens of an account of the Typhoon of July 31st, 1879. So great was the impression created by this article amongst the merchants of Shanghai that a typhoon signal service for all parts of the China coast was quickly established. Since 1896 daily weather maps and forecasts have been prepared and information distributed by telegram to all concerned, and it is interesting to note that, by a special form of code, the latitude, longitude and degree of violence of a typhoon is completely signalled by semaphore to local shipping. The Supplement also contains an excellent reproduction of the Galitzin seismograph record of the Japanese earthquake of September last as registered at Siccawei.

The Standard of Time in the Far East

FROM a paper by Dr. J. Boerema, on "A new determination of the eastern longitude of Batavia," we learn that Central Java time has been fixed as Mean Time for the meridian 110° East of Greenwich. In Dr. Boerema's investigation the longitude of his observatory was found by the use of the wireless time signals from Bordeaux. The correction to the previously accepted longitude is only 0·617 second of time: Dr. Boerema thinks that a systematic error of this order of magnitude will be found in the accepted longitudes of all stations east of Singapore.

Red Lightning

WITH reference to a thunderstorm which occurred at Ross-on-Wye on June 17th, 1924, Miss Mary L. Southall writes:—

> "The rainfall during the storm was only ·33 inch. The storm, after rumbling in the distance some time previously, came on at about 7h. 45m. and lasted till about 8h. 30m. (Greenwich Time). I have known more alarming flashes and peals, but the flashes seemed to last longer and as if they were playing about in the gardens of the opposite houses and lighting up the walls of the houses. They were accompanied by rain and wind. I think I have seen quite as brilliant lightning with white light at night, but I do not remember a storm characterised by such redness of the lightning. It was almost as though coloured lights (as used in fireworks) had been let off. A farmer, who lives a few miles away, was out in the storm and he too thought he had not seen lightning quite like it. One flash, he said, was 'like a purple cord' coming down from the sky. I should be very much interested to know if red lightning is considered less dangerous than white?"

An Observation which may Refer to Parry's Upper Arc

THE following note is based on a report from Flying Officer R. C. Bryant, senior Meteorological Officer in Iraq :—

> On Thursday, March 20th, 1924, at 5h. G.M.T., a solar halo was observed at Hinaidi (Lat. 33° 17′ N., Long. 44° 29′ E.). At the time the sky was wholly covered with cirro-stratus and alto-stratus moving from south-west. At 5h. 4m. an arc convex to the halo was observed to be forming. The length of this arc was approximately equal to the radius of the circular halo, and the distance away from the halo was roughly one-third of that radius. The sequence of colours was as that of the halo around the sun. It remained visible for a period of seven to ten minutes, then abruptly disappeared. The true halo remained visible for some considerable time afterwards.

On the assumption that the circular halo was the halo of 22°, the arc cannot have been the circumzenithal arc, which is more than 45° from the sun. The only known arc near the right position would seem to be Parry's Upper Arc. This is the arc attributed by Hastings to refraction of light through hexagonal prisms settling down with not only their axes horizontal, but also the upper and lower faces.

Perhaps some reader will work out the theoretical position and shape of Parry's Upper Arc at the time specified by Flying Officer Bryant ?

The McLeod Sunshine Recorder

IN the obituary notice of Herbert McLeod, recently published in the "Proceedings of the Royal Society" it is stated that "His Sunshine Recorder, in which the sun's light and heat from its unclouded disc are concentrated by means of a glass ball on prepared paper, whereby the duration of the sunshine is indicated by the trail of charred paper, is also well known, and is in very general use."

The description quoted applies to the Campbell-Stokes sunshine recorder, the use of the glass ball being due to Mr. J. F. Campbell, of Islay, the specification* of the card holder to Sir George Stokes. McLeod's instrument was devised in 1884. A record obtained with it is reproduced in *Nature*, February 5th, 1885. The image of the sun formed by reflection in a bright hemisphere (the silvered inner surface of a flask) was photographed on ferro-prussiate paper. We do not know whether more than the one instrument was ever set up. Certainly it is not "in very general use."

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* Q. J. R. Met. Soc. Vol. vi., April 1880, p. 83.

A Photograph of an Elliptic Halo

ON June 18th, 1924, Mr. G. A. Clarke succeeded at Aberdeen in photographing an elliptic halo. The following notes are taken from his description. Unfortunately, the photograph is not suitable for reproduction in a half-tone block.

> " This is a very poor photograph of what might in other circumstances have been a magnificent study. Just about 12h. 30m. on June 18th, a sheet of cirro-nebula covered the southern portion of the sky, and the ice-crystal layer was perfectly structureless. In it there was seen a very fine halo of 22° with the upper and lower ' arcs of contact ' bent down, and meeting, thus forming a complete ' ellipse ' round the circular halo. All the branches on the left were strongly coloured from the orange to the yellow green, with a bluish white beyond the green. The phenomenon was rapidly fading while the cloud layer was increasing in density and becoming floccular in places, as shown by the photograph. By the time my camera was ready, the halo was becoming faint, very faint indeed near the ' elliptical ' part. Still, if this photograph be held at arm's length the two easterly arcs, circular and elliptical, will be seen. The photograph, which was taken in order to enable measurement of the ' semi-major axis ' of the ellipse to be made, gives 26°—the radius of the circular halo being assumed to be 22°. I wish I had seen the halo early enough to have obtained a good photograph of it."

Aeroplanes and Thunderstorms

A PARAGRAPH which recently appeared in the press would seem to indicate that the problem of locating thunderstorms, and tracing their direction and rate of movement, has been completely solved by wireless direction-finding, and that pilots of aeroplanes are now warned by radio-telephony of the exact position and line of movement of thunderstorms.

Unfortunately this ideal has not yet been attained. It is a well known fact that some relation exists between the type and intensity of atmospheric disturbances, heard by means of an ordinary wireless receiving set, and the intensity or distance of thunderstorms. Experiments are still being carried out with a view to determining exactly what that relation is. In particular simultaneous observations are being made at the meteorological station at Croydon, and by Captain Cave at Petersfield, in an endeavour to ascertain whether the actual type of apparatus in use, designed by Mr. Watson Watt, can be effectively used in locating thunderstorms.

At present reports of thunderstorms to pilots take their place in the ordinary list of dangerous phenomena which are reported specially to pilots in the air, when such phenomena are observed near and are likely to affect the London Continental Aerial Routes. In addition to thunderstorms such phenomena as squalls, fog and very low cloud receive special attention.

The Loss of the French Airship "Dixmude"

THE following extract from "Aviation" of June 16th, 1924, is of interest in connection with the article on the above which appeared in the *Meteorological Magazine* of last February :—

> "A bottle found May 18th on the beach at Propriano, south-western Corsica, contained a farewell note of the ill-fated 'Dixmude' airship crew. The message, written in pencil, read : 'All out of gasoline. We are drifting in a wind storm. Good-bye and long live France.—Dixmude crew.'"

The Smoke-Screen over Paris

IN his report for the year 1923, M. Besson publishes the results of his researches on the loss of light due to smoke in the neighbourhood of Paris. The observations utilised were made with the Bellani lucimeter, an instrument which may be regarded as a combination of the black bulb thermometer and the Wilson radiointegrator. A bulb of blue glass is enclosed in a larger bulb from which the air is exhausted, and the amount of spirit distilled from the smaller bulb gives a measure of the amount of radiation. The calibration of the instruments is somewhat difficult, and no attempt seems to have been made to compare them with any absolute standard. Nevertheless, comparative results of considerable value have been obtained. It is shown how the radiation in the suburbs is affected by the direction of the wind. For example, at Ville-Evrard, 6 miles from the fortifications, there is a loss of 21 per cent. in the radiation when the wind blows from the city. The loss at the Tour Saint-Jacques, in the centre of Paris, averages 19 per cent. ; it is greatest on days with no direct sunshine, when it amounts to no less than 68 per cent.

The Determination of the Height of Clouds

THE same report also contains an article on the height and velocity of alto-cumulus and strato-cumulus clouds. Perhaps the most important point in this article is that it shows the practicability of the method used at Montsouris for the deter-

mination of the height of clouds. The method is due in the first instance to Bravais; it depends on the exact measurement of the angle between rays reaching the observer from the cloud and from its image in a sheet of water. At Montsouris the sheet of water is merely a large artificial puddle which can easily be kept clean. The fact that during the four years 1919-1922 the height of alto-cumulus was measured 946 times, and that of strato-cumulus 299 times, should recommend the system to all interested in clouds.

The Influence of Climatic Conditions on the shape of the Nose

DR. ARTHUR THOMSON and L. H. D. BUXTON have recently published an interesting paper on "Man's Nasal Index in relation to certain climatic conditions." The nasal index is one hundred times the breadth of the nose divided by its height, thus a broad flat nose has a higher nasal index than a high and narrow one. The variation in this respect is very marked; among some groups of negroes the nasal index averages as high as 105, while among the races inhabiting the high plateaux of Asia, with a cold dry climate, it falls below 60. In general a short broad nose is associated with a damp moist climate, and a high narrow nose with a cold dry climate. The authors seek to give precision to this generalisation, and for this purpose compare the results of many thousand measurements of the nasal index, both on the living subject (101 local groups) and on skulls (98 local groups), with the corresponding mean annual temperature and humidity. Between the limits of 50° and 90° F. the agreement is good; the nasal index of living subjects is given by the formula:

$$\text{Nasal index (living)} = \text{temperature (°F.)} \times 0{\cdot}483 + \text{humidity (per cent.)} \times 0{\cdot}253 + 24{\cdot}91,$$

and the coefficient of correlation between the observed and calculated values is $+ 0{\cdot}72 \pm {\cdot}03$. The result given by measurements of skulls is not quite so good: $r = + 0{\cdot}55 \pm {\cdot}05$.

The physiological meaning of this relationship is that one of the purposes of the nose is to raise the temperature and humidity of inhaled air before it enters the lungs. The colder and drier the air, the greater the need for this function, so that in a race which has lived long in a cold dry environment the nasal passages become long, and the nose high and narrow. After migration from one type of environment to the other the adjustment is not immediate but takes many generations, thus the high narrow noses of the dominant castes in India agree with the historical fact that the latter are comparatively recent immigrants from the north. The fossil skulls found in Europe

indicate very high narrow noses during the Ice Age, gradually becoming shorter and broader as the climate improved. The question whether this adjustment is due to natural selection or to the inheritance of acquired characters is not discussed.

Amendments to Reference Table—Climatological Table for the British Empire

A REFERENCE TABLE, giving the height, hours of observations, &c., for all the stations used in the Climatological Table for the British Empire, was published in the *Meteorological Magazine* for July, 1922, p. 174. The following is a list of changes that have taken place since that date :—

LONDON—KEW OBSERVATORY	Hours changed to 7h., 13h., 21h. in January, 1923. New normals (1881-1915) adopted for pressure in January, 1923.
GIBRALTAR	From March, 1923, mean max. and min. temp. refer to 24-hr. means. New normals (66 years, 1852-1920) adopted for all elements in January, 1924.
MALTA	From March, 1923, mean max. and min. temp. refer to 24-hr. means.
SIERRA LEONE	Authority—Sanitary Department, Freetown.
LAGOS, NIGERIA	From April, 1922, Latitude 6° 27′ N, Longitude 3° 24′ E, and hours of observation 9h. and 15h.
KADUNA, NIGERIA	Authority — The Surveyor-General, Lagos.
SALISBURY, RHODESIA ...	Height previous to 1st January, 1924, 4,834 ft., subsequently 4,860 ft.
BLOEMFONTEIN	Authority :—G. H. Schepers, Esq., Grey College.
CALCUTTA	Hours of observation, 8h. from September, 1922.
BOMBAY	Hours of observation, 8h. from October, 1922.
MADRAS	Hours of observation 8h. from September, 1922.
COLOMBO	Hours of observation, 9½h. and 15½h. from January, 1923, for cloud amount.
SANDAKAN	Hours of observation, 9h., 15h., 21h. from April, 1923.
SYDNEY	Height 138 ft. from 1st July, 1922.
COOLGARDIE	Latitude, 30° 57′ S.
KINGSTON, JAMAICA	Latitude, 17° 58′ N, Longitude 76° 48′ W, height 111 ft., and New normals (1881-98 ; 1908-22) adopted for pressure in January, 1924.
ST. JOHN, N.B.	Height, 119 ft.

At the following stations " mean wet bulb " is obtained from the extremes for the 24 hours instead of from observations at fixed hours. This value, together with ½ (max. + min.) dry bulb, is used for the computation of relative humidity :—Sydney, Perth, Wellington.

The British Empire Exhibition at Wembley: Atmospheric Pollution

THE work of the Advisory Committee on Atmospheric Pollution is illustrated at Wembley by a collection of exhibits in the Ministry of Health Section. The amount of soot which falls in London and other places is shown in various ways. There is a model entitled "The Londoner's Burden," representing a man carrying a large sack of soot, the soot-fall of one second. Another model represents Westminster Abbey, and on the same scale the deposit of soot for one year. Perhaps the most pleasing exhibit is a diagram showing the improvement in the purity of the London atmosphere between 1916 and 1924. The need for further improvement is brought out by the collection of building stones, all of which have deteriorated more or less under the influence of the London smoke.

News in Brief

Sir Napier Shaw, F.R.S., Professor of Meteorology in the Imperial College of Science and Technology, formerly Director of the Meterological Office, has been elected a foreign member of the Royal Swedish Academy of Science in respect of his "masterly researches in the domain of Meteorology."

Prof. S. Chapman, F.R.S., whose name is familiar to meteorologists for his work on atmospheric tides and similar phenomena has been appointed to the chief professorship of mathematics at the Imperial College of Science and Technology in succession to Prof. A. N. Whitehead, F.R.S., who has been appointed to the chair of philosophy at Harvard University, U.S.A.

We note with regret the sad termination of the Mount Everest Expedition, the loss of G. Leigh-Mallory and A. C. Irvine. Col. Norton and Dr. Somervell had succeeded in reaching a height of 28,000 feet, and it is surmised that Mr. Mallory and Mr. Irvine went higher still before they were overcome.

The Weather of June, 1924

DURING the first part of the month unsettled rainy conditions prevailed generally, but about the 14th there was a change to warmer, drier weather with, however, a good deal of cloud in some parts.

The heavy rainfall referred to in last month's report continued

on the 1st, and measurements in some parts of the country were exceptionally large. The resulting floods continued for some days. Under the influence of the anticyclone near Iceland, fairer conditions prevailed in Scotland until the 6th, but rather cool unsettled weather was general in the south with occasional thunder. A depression which passed across south England on the 4th, brought heavy rain locally [54 mm. (2·12 ins.) at Patching Farm, Sussex], but in the rear of this depression a temporary improvement was experienced in the southern and eastern counties and temperature rose slightly above 70°F. at many places on the 7th. After this, cyclonic conditions prevailed again over the whole of the British Isles, until nearly the middle of the month. On the 13th the high pressure area to the south of Iceland moved south-eastwards towards England, and fairer conditions set in. A cold northerly wind, however, prevailed on that day so that temperature failed to rise above 56°F. in many of the southern districts. Subsequently temperature rose gradually: 75°F. was exceeded in places and 79°F. occurred in London (Camden Square) on the 17th, when a depression moving northwards from the Bay of Biscay caused thunderstorms in many parts and rather heavy rain in places. From the 19th onwards, the weather in the south-east continued fair and warm with very little rain—80°F. was exceeded on the 26th at many places. In the west and north, however, unsettled, rainy conditions were maintained, so that in parts of these districts the total rainfall for the month was twice and in some places three times the normal. At The Stye, Borrowdale, the total was 376 mm. (14·8 ins.), at Llyn Llydaw 295 mm. (11·6 ins.), and at Inveraray 237 mm. (9·34 ins.). At the latter place heavy falls 62 mm. (2·44 ins.) and 63 mm. (2·49 ins.) occurred on the 20th and 24th, and the observer writes that "on the 20th there was an exceptionally heavy hailstorm within an area of two miles which lasted for about an hour and a half, the streets and fields being flooded with water in a short time. At Auchnangoul, about 3 miles distance, no hail fell and the farmers were at work in bright sunshine. The same applies to the 24th when the heavy rain was again very local." The total sunshine for the month (91 hours) at Valencia was the lowest June report since sunshine observations began there in 1881.

Ground frosts occurred many times throughout the month, and a reading as low as 22° F. was registered at Rounton on the 3rd. A remarkable disturbance of a tornado-like character was experienced in the centre of Belfast on the evening of the 24th.

Although the weather on the Continent was mainly unsettled, many high temperatures were recorded, the highest being 104°F. at Turin on the 25th. Dusseldorf was visited on the 8th by a

severe storm, which did a large amount of damage to property, but fortunately the casualties were few. At 2 p.m. the sky was suddenly darkened and torrents of rain and hail fell, flooding the town. In the south-western districts a whirlwind uprooted trees, blew down factory chimneys, and the steeple of St. Martin's Church fell. Early on the 17th a dense fog at Vest Fjord in the north of Norway was responsible for a collision between two passenger steamers in which 17 people were drowned. Heavy rains have been reported from Smyrna and other districts of Asia Minor, and the resulting floods have done much damage to the crops. According to a telegram published in *The Times* the temperature in Calcutta on May 31st, was 115°, the highest ever recorded in the city. (108°F. is the highest temperature recorded during the years 1878—1920 at Alipore Observatory, which is regarded as giving authoritative values for Calcutta). During the middle of the month, excessive rains were reported from the districts surrounding the Gulf of Bengal, while the rainfall in the extreme north of India was scanty. Reports of floods in the United States were again received, but this month from Tennessee. The towns of Carter's Bluff and Hunter and also many villages were inundated and partially destroyed, with a number of fatalities. On the 28th, late in the afternoon, a violent hurricane swept along the southern shores of Lake Erie, and took a heavy toll of life. At Lorain, where the State Theatre collapsed, some 300 persons were reported to have been killed, and many houses in the main street were blown down. It is believed that three pleasure steamers on Lake Erie are lost, but full details of the disaster are not yet known. Useful rains have fallen in Queensland and New South Wales.

The special message from Brazil states that in the north the total rainfall for the month was 73 mm. above the normal, and in the central and southern districts 40 mm. above normal, and 8 mm. below normal respectively. The distribution in these last two districts was, however, irregular. High pressure systems have been more frequent and the depressions more active during this month than in April or May. In general, the pressure distribution during the last few months has been abnormal. At Rio de Janeiro temperature was 5°F. above normal while pressure was only slightly above normal.

Rainfall June, 1924: General Distribution

England and Wales	104	per cent. of the average 1881-1915.
Scotland	108	
Ireland	129	
British Isles	110	

Rainfall: June, 1924: England and Wales.

CO.	STATION.	In.	mm.	Per-cent. of Av	CO.	STATION.	In.	mm.	Per-cent. of Av.
Lond.	Camden Square.....	2·47	63	122	*War.*	Birminghm, Edgbaston	2·54	65	109
Sur .	Reigate, Hartswood...	2·72	69	139	*Leics*	Leicester Town Hall...	2·13	54	...
Kent.	Tenterden, Ashenden..	1·67	42	...	,, .	Belvoir Castle.....	2·29	58	120
,, .	Folkestone, Boro. San.	1·49	38	...	*Rut .*	Ridlington.....	2·78	71	...
,, .	Broadstairs	...	..	...	*Linc.*	Boston, Skirbeck	2·01	51	110
,, .	Sevenoaks, Speldhurst.	3·05	77	...	,, .	Lincoln, Sessions House	1·19	30	59
Sus .	Patching Farm.....	4·00	102	198	,, .	Skegness, Estate Office.	·98	25	54
,, .	Eastbourne, Wilm. Sq.	1·83	47	99	,, .	Louth, Westgate	1·62	41	75
,, .	Tottingworth Park....	2·08	53	99	,, .	Brigg	1·57	40	75
Hants	Totland Bay, Aston...	1·94	49	105	*Notts.*	Worksop, Hodsock....	·99	25	50
,, .	Fordingbridge, Oaklnds	1·95	49	105	*Derby*	Mickleover, Clyde Ho..	2·18	55	91
,, .	Portsmouth, Vic. Park.	3·28	83	182	,, .	Buxton, Devon. Hos...	2·70	69	84
,, .	Ovington Rectory	2·82	72	122	*Ches.*	Runcorn, Weston Pt...	2·48	63	96
,, .	Grayshott	3·57	91	159	,, ..	Nantwich, Dorfold Hall	1·82	46	...
Berks	Wellington College...	2·73	69	126	*Lancs*	Bolton, Queen's Park .	2·95	75	...
,, .	Newbury, Greenham..	3·03	77	140	,, ..	Stonyhurst College....	2·92	74	95
Herts.	Bennington House....	1·72	44	83	,, ..	Southport, Hesketh...	1·91	49	88
Bucks	High Wycombe	3·03	77	155	,, ..	Lancaster, Strathspey.	2·84	72	...
Oxf..	Oxford, Mag. College..	2·27	58	107	*Yorks*	Sedbergh, Akay	5·41	137	163
Nor .	Pitsford, Sedgebrook..	1·80	46	93	,, .	Wath-upon-Dearne ...	1·62	41	73
,, .	Eye, Northolm.....	1·72	44	...	,, .	Bradford, Lister Pk...	1·83	47	78
Beds.	Woburn, Crawley Mill.	2·34	59	118	,, .	Oughtershaw Hall	3·95	100	...
Cam.	Cambridge, Bot. Gdns.	1·99	51	94	,, .	Wetherby, Ribston H..	1·94	49	92
Essex	Chelmsford, CountyLab	1·37	35	...	,, .	Hull, Pearson Park ...	1·76	45	85
,, .	Lexden, Hill House...	1·82	46	...	,, .	Holme-on-Spalding ...	1·96	50	...
Suff .	Hawkedon Rectory ...	1·48	38	71	,, .	Lowthorpe, The Elms.	1·29	33	70
,, .	Haughley House.....	1·47	37	...	,, .	West Witton, Ivy Ho..	·98	25	...
Norf.	Beccles, Geldeston....	1·87	48	104	,, .	Pickering, Hungate ...	1·34	34	...
,, .	Norwich, Eaton	1·60	41	83	,, .	Middlesbrough.....	1·49	38	79
,, .	Blakeney	·96	24	52	,, .	Baldersdale, Hury Res.	1·44	37	61
,, .	Swaffham	1·46	37	68	*Durh.*	Ushaw College	2·17	55	100
Wilts.	Devizes, Highclere....	2·32	59	103	*Nor .*	Newcastle, Town Moor.	2·23	57	103
Dor .	Evershot. Melbury Ho.	1·80	46	79	,, .	Bellingham Manor....	·92	23	...
,, .	Weymouth. Westham..	1·62	41	91	,, .	Lilburn Tower Gdns...	2·90	74	...
,, .	Shaftesbury, Abbey Ho.	1·73	44	75	*Cumb*	Penrith, Newton Rigg..	...	..	...
Devon	Plymouth, The Hoe...	1·43	36	68	,, .	Carlisle, Scaleby Hall .	1·52	39	60
,, .	Polapit Tamar	2·16	55	100	,, .	Seathwaite	8·20	208	126
,, .	Ashburton, Druid Ho..	3·02	77	118	*Glam.*	Cardiff, Ely P. Stn.....	3·02	77	121
,, .	Cullompton	3·62	92	171	,, .	Treherbert, Tynywaun	4·97	126	...
,, .	Sidmouth, Sidmount ..	3·59	91	171	*Carm*	Carmarthen Friary....	3·04	77	106
,, .	Filleigh, Castle Hill ...	3·76	95	...	,, .	Llanwrda, Dolaucothy.	5·04	128	148
,, .	Hartland Abbey.....	1·53	39	...	*Pemb*	Haverfordwest, Portf'd	3·39	86	126
Corn.	Redruth, Trewirgie ...	1·93	49	77	*Card.*	Gogerddan.....	4·16	106	134
,, .	Penzance, Morrab Gdn.	1·56	40	70	,, .	Cardigan, County Sch. .	2·95	75	...
,, .	St. Austell, Trevarna..	2·20	56	85	*Brec .*	Crickhowell, Talymaes	3·50	89	...
Soms	Chewton Mendip	3·56	90	120	*Rad .*	Birm.W.W.Tyrmynydd	2·87	73	88
,, .	Street, Hind Hayes ...	2·92	74	...	*Mont.*	Lake Vyrnwy	...	..	...
Glos..	Clifton College	3·41	87	137	*Denb.*	Llangynhafal	1·85	47	...
,, .	Cirencester	2·79	71	113	*Mer .*	Dolgelly, Bryntirion..	4·35	111	125
Here.	Ross, County Obsy. ...	...	..	...	*Carn.*	Llandudno	2·17	55	107
,, .	Ledbury, Underdown.	3·13	79	138	,, .	Snowdon, L. Llydaw 9	11·61	295	...
Salop	Church Stretton.....	2·84	72	117	*Ang .*	Holyhead, Salt Island.	2·84	72	132
,, .	Shifnal, Hatton Grange	2·56	65	115	,, .	Lligwy	2·18	55	...
Staff.	Tean, The Heath Ho...	2·77	70	107	*Isle of Man*				
Worc.	Ombersley, Holt Lock.	...	...	...		Douglas, Boro' Cem...	3·43	87	139
,, .	Blockley, Upton Wold.	2·47	63	93	*Guernsey*				
War.	Farnborough.....	1·49	38	63		St. Peter Port Grange.	1·13	29	61

Rainfall: June, 1924: Scotland and Ireland

CO.	STATION	In.	mm.	Per-cent. of Av.	CO.	STATION.	In.	mm.	Per-cent of Av.
Wigt.	Stoneykirk, Ardwell Ho	2·69	68	111	*Caith*	Loch More, Achfary...	5·41	137	146
,, .	Pt. William, Monreith .	2·84	72	...	,, ..	Wick	1·44	37	80
Kirk.	Carsphairn, Shiel.	3·13	79	...	*Ork* .	Pomona, Deerness	1·72	44	93
,, .	Dumfries, Cargen.....	1·73	44	62	*Shet* .	Lerwick	2·23	57	125
Dum	Drumlanrig	2·14	54	87					
Roxb	Branxholme	1·58	40	70	*Cork.*	Caheragh Rectory	5·70	145	...
Selk .	Ettrick Manse.....	2·09	53	...	,, ..	Dunmanway Rectory.	5·18	132	148
Berk.	Marchmont House	2·38	61	103	,, ..	Ballinacurra	3·84	97	148
Hadd	North Berwick Res....	1·69	43	102	,, ..	Glanmire, Lota Lo.	4·10	104	152
Midl	Edinburgh, Roy. Obs..	1·77	45	91	*Kerry*	Valencia Obsy.	4·97	126	155
Lan .	Biggar	1·24	31	60	,, .	Gearahameen	7·50	191	...
Ayr .	Kilmarnock, Agric. C..	2·73	69	124	,, .	Killarney Asylum.....	5·21	132	179
,, .	Girvan, Pinmore.....	2·80	71	97	,, .	Darrynane Abbey	...	..	...
Renf.	Glasgow, Queen's Pk..	1·86	47	81	*Wat* .	Waterford, Brook Lo..	3·39	86	126
,, .	Greenock, Prospect H..	3·27	83	99	*Tip* .	Nenagh, Cas. Lough...	3·60	91	147
Bute.	Rothesay, Ardencraig.	3·06	78	100	,, .	Tipperary	3·07	78	...
,, .	Dougarie Lodge	3·09	79	...	,, .	Cashel, Ballinamona ..	3·66	93	159
Arg .	Glen Etive.....	...	..	...	*Lim* .	Foynes, Coolnanes	4·74	120	184
,, .	Oban	5·35	136	...	,, .	Castleconnell Rec.	5·03	128	...
,, .	Poltalloch	5·36	136	179	*Clare*	Inagh, Mount Callan ..	5·54	141	...
,, .	Inveraray Castle.....	9·34	237	236	,, .	Broadford, Hurdlest'n.	4·27	109	...
,, .	Islay, Eallabus.....	3·33	85	127	*Wexf*	Newtownbarry	3·09	79	...
,, .	Mull, Benmore	13·80	351	...	,, .	Gorey, Courtown Ho...	2·71	69	112
Kinr.	Loch Leven Sluice	1·81	46	83	*Kilk.*	Kilkenny Castle	3·80	97	156
Perth	Loch Dhu	4·20	107	101	*Wic* .	Rathnew, Clonmannon	2·51	64	...
,, ..	Balquhidder, Stronvar.	2·56	65	67	*Cars.*	Hacketstown Rectory .	3·62	92	129
,, ..	Crieff, Strathearn Hyd.	1·76	45	67	*QCo.* .	Blandsfort House.....	4·24	108	...
,, ..	Blair Castle Gardens ..	1·73	44	...	,,	Mountmellick	3·40	86	...
,, .	Coupar Angus School..	1·84	47	98	*KCo.*	Birr Castle.....	2·88	73	125
Forf.	Dundee, E. Necropolis.	2·17	55	121	*Dubl.*	Dublin, FitzWm. Sq...	2·78	71	143
,, .	Pearsie House.....	1·83	47	...	,, .	Balbriggan, Ardgillan .	2·20	56	109
,, .	Montrose, Sunnyside..	1·40	36	84	*Me'th*	Drogheda, Mornington	2·33	59	...
Aber.	Braemar Bank	1·45	37	76	*W.M*	Mullingar, Belvedere .	3·11	79	120
,, .	Logie Coldstone Sch. ..	2·13	54	109	*Long*	Castle Forbes Gdns....	3·24	82	125
,, .	Aberdeen, Cranford Ho	2·05	52	114	*Gal* .	Galway, Waterdale ...	...	..	...
,, .	Fyvie Castle	1·41	36	...	,, .	Ballynahinch Castle ..	6·60	168	...
Mor .	Gordon Castle.....	2·65	67	130	*Mayo*	Mallaranny.....	7·23	184	...
,,	Grantown-on-Spey....	2·29	58	102	,, .	Westport House.....	3·26	83	121
Na .	Nairn, Delnies.....	2·23	57	127	,, .	Delphi Lodge	8·63	219	...
Inv..	Ben Alder Lodge	2·13	54	...	*Sligo*	Markree Obsy.	4·55	116	155
,, .	Kingussie, The Birches	1·83	47	...	*Ferm*	Enniskillen, Portora ..	3·69	94	...
,, .	Fort Augustus	2·43	62	120	*Arm.*	Armagh Obsy.	2·37	60	94
,, .	Loch Quoich, Loan....	11·40	290	...	*Down*	Warrenpoint	3·22	82	...
,, .	Glenquoich	7·74	197	158	,, .	Seaforde	3·80	97	138
,, .	Inverness, Culduthel R.	2·29	58	...	,, .	Donaghadee	2·30	59	99
,, .	Arisaig, Faire-na-Squir	4·86	123	...	,, .	Banbridge, Milltown .	2·55	65	99
,, .	Fort William.....	4·94	125	141	*Antr.*	Belfast, Cavehill Rd. ..	4·61	117	...
,, .	Skye, Dunvegan.....	3·93	100	...	,, .	Glenarm Castle.....	3·04	77	...
,, .	Barra, Castlebay	1·83	47	...	,, .	Ballymena, Harryville	4·08	104	140
R&C	Alness, Ardross Cas. ..	2·16	55	96	*Lon* .	Londonderry, Creggan	2·70	69	96
,, .	Ullapool.....	2·72	69	...	*Tyr* .	Donaghmore	3·30	84	...
,, .	Torridon, Bendamph..	6·33	161	155	,, .	Omagh, Edenfel	2·76	70	98
,, .	L. Carron, Plockton...	4·53	115	...	*Don* .	Malin Head	2·36	60	110
,, .	Stornoway	3·33	85	143	,, .	Rathmullen.....	2 52	64	...
Suth.	Lairg	2·43	62	...	,, .	Dunfanaghy	3·00	76	105
,, .	Tongue Manse.....	2·58	65	126	,, .	Narin, Kiltoorish	3·78	96	...
,, .	Melvich School.....	2·08	53	107	,, .	Killybegs, Rockmount.	5·02	127	132

Climatological Table for the British Empire, January, 1924

STATIONS	PRESSURE		TEMPERATURE							Relative Humidity	Mean Cloud Am'nt	PRECIPITATION			BRIGHT SUNSHINE	
			Absolute		Mean Values				Mean							
	Mean of Day M.S.L.	Diff. from Normal	Max.	Min.	Max.	Min.	½ max. and min.	Diff. from Normal	Wet Bulb.			Am'nt	Diff. from Normal	Days	Hours per day	Percentage of possible.
	mb.	mb.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	%	0—10	mm.	mm.			
London, Kew Obsy.	1014·9	— 2·7	52	26	45·4	37·3	41·3	+ 2·4	41·2	87	7·2	64	+ 19	16	1·7	21
Gibraltar	1019·2	— 2·0	69	43	60·6	48·5	54·5	— 0·3	51·2	78	5·7	126	— 3	12	...	...
Malta	1014·6	— 1·6	63	40	56·5	48·9	52·7	— 1·6	48·9	79	5·7	73	— 2	15	5·3	53
Sierra Leone	1010·9	— 0·3	94	62	88·5	73·8	81·1	— 0·4	74·5	70	3·3	2	— 9	2	...	...
Lagos, Nigeria	1008·7	— 1·2	91	65	89·5	74·8	82·1	+ 1·1	76·5	71	6·3	49	+ 21	4	...	...
Kaduna, Nigeria	1014·1	+ 2·5	93	...	88·2	...	...	...	60·4	46	0·9	0	0	0	...	...
Zomba, Nyasaland	1009·5	+ 1·6	87	60	81·2	64·5	72·9	+ 0·5	...	89	7·3	194	— 91	22	...	...
Salisbury, Rhodesia	1008·6	— 0·7	87	55	81·5	59·3	70·4	+ 0·9	62·6	58	4·1	64	—137	6	...	...
Cape Town	1013·7	+ 0·3	99	51	81·6	61·8	71·7	+ 1·9	64·9	57	2·6	7	— 10	2	...	...
Johannesburg	1011·1	+ 1·0	89	49	81·0	57·5	69·3	+ 3·1	57·5	57	4·3	99	— 60	13	8·7	64
Mauritius	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Bloemfontein	...	...	101	48	88·9	62·2	75·5	+ 2·3	61·6	48	3·6	97	— 5	9	...	...
Calcutta, Alipore Obsy.	1016·7	+ 1·5	84	52	78·0	58·3	68·1	+ 1·7	57·7	81	4·0	6	— 4	1*	...	...
Bombay	1013·5	+ 0·3	86	61	82·7	68·0	75·3	+ 0·1	65·4	73	2·3	0	— 2	0*	...	...
Madras	1015·0	+ 0·9	86	64	84·0	68·4	76·2	+ 0·1	70·9	84	3·7	60	+ 37	4*	...	...
Colombo, Ceylon	1011·5	+ 0·7	91	70	87·4	72·8	80·1	+ 0·3	75·6	68	4·4	65	— 26	7	8·5	72
Hong Kong	1019·9	+ 0·5	75	47	65·9	59·8	62·9	+ 2·6	58·9	81	7·5	27	— 10	9	3·3	30
Sandakan	...	...	88	73	85·4	75·1	80·3	+ 0·4	76·2	81	...	275	—194	13	...	...
Sydney	1009·1	— 3·4	98	55	80·3	64·4	72·3	+ 0·7	64·4	62	4·0	122	+ 31	11	9·2	65
Melbourne	1010·4	— 2·5	104	46	74·4	55·5	64·9	— 2·6	58·1	60	5·6	73	+ 26	12	6·8	47
Adelaide	1013·2	+ 0·2	105	48	79·8	57·3	68·5	— 5·6	57·9	48	4·2	18	0	8	9·4	67
Perth, W. Australia	1014·4	+ 1·9	106	53	81·8	60·4	71·1	— 2·7	60·8	52	3·2	8	— 1	4	10·1	78
Coolgardie	1012·1	+ 0·7	106	51	91·6	59·9	75·7	— 1·7	62·1	32	2·1	0	— 12	0	...	...
Brisbane	1008·9	— 2·4	100	63	88·3	70·2	79·3	+ 2·1	71·6	63	5·2	58	—105	9	8·2	60
Hobart, Tasmania	1006·1	— 4·2	89	41	66·2	50·6	58·4	— 3·9	52·0	64	6·9	138	+ 93	20	7·2	48
Wellington, N.Z.	1012·3	— 0·5	84	46	71·5	57·4	64·5	+ 1·8	...	70	5·8	57	— 29	12	7·9	53
Suva, Fiji	1007·5	— 0·5	89	69	86·1	73·3	79·7	— 0·2	75·5	77	4·7	231	— 41	18	...	...
Kingston, Jamaica	1015·8	+ 0·5	91	65	86·9	68·2	77·5	+ 0·7	69·5	65	4·0	13	— 11	3	...	...
Grenada, W.I.	1015·3	+ 2·5	85	70	81·6	71·7	76·7	— 0·3	72·0	75	4·5	121	+ 8	23	...	...
Toronto	1019·6	+ 2·2	43	— 6	30·8	16·0	23·4	+ 1·3	20·8	52	6·8	124	+ 51	20	2·0	22
Winnipeg	1020·6	+ 0·8	38	—31	4·8	—11·9	— 3·5	+ 0·9	...	...	4·5	11	— 8	10	2·5	29
St. John, N.B.	1016·7	+ 1·0	49	—19	30·7	9·8	20·3	+ 1·1	18·3	63	5·5	134	+ 12	17	4·0	44
Victoria, B.C.	1020·4	+ 5·1	55	17	43·9	36·7	40·3	+ 0·2	38·1	88	8·1	67	— 48	16	1·7	20

* For Indian stations a rain day is a day on which 0·1 in. (2·5 mm.) or more rain has fallen.

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On Rainfall of very Rare Intensity

By F. J. W. WHIPPLE, M.A., F.Inst.P.

THE storms in which exceedingly heavy rainfall occurs are of great interest not only to the witnesses and victims, but also to the engineers who have to make provision for carrying away excessive flood water and to the physicists who speculate on the mechanism by which the rainfall is produced. Since 1868 a section of *British Rainfall* has been devoted to "Heavy Rains in Short Periods." Correspondents have occasionally shown scepticism with regard to the validity of the entries in this table, and have been able to point out that some, at any rate, depended on comparatively rough estimates of the amount of rain or of the time during which it fell. Perhaps insufficient stress has been laid on the fact that one set of observations existed which could be regarded as a standard of reference, in that, whilst the intensities had seldom been surpassed, the record was made with appropriate apparatus. As far as I know, there is no autographic rain-gauge in existence such that time can be read to within a few seconds: if we want to learn how much rain can fall in a minute we must be able to estimate the time with precision. Symons turned the difficulty by trusting to direct observations of the movement of a float. From *British Rainfall* 1877 we learn that it was in 1865 that he set up a storm rain-gauge "to show at a distance of 80 ft. the amount of fall, minute by minute." This gauge was found to have two drawbacks, the risk of damage in frosty weather and

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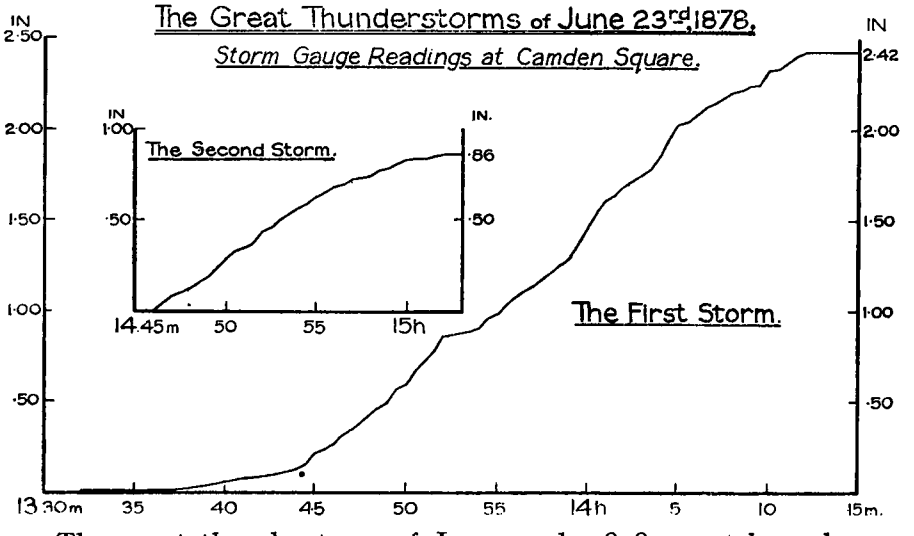
the difficulty of observing at night. In 1875 Symons' illuminated Storm Gauge was made by Pastorelli, and set up at Camden Square. With this gauge the amount of rainfall was shown by two hands on a dial, the little hand showing the number of inches, the big hand the hundredths. The movement of the big hand was controlled directly by a float: that of the little hand by gearing. When the gauge was in the garden at Camden Square the open scale could be read by the naked eye from the window of Symons' room. This gauge is now in the Science Museum. Whether any similar gauges are in use elsewhere, I do not know. There was one at the Bristol Docks in 1876.



The great thunderstorm of June 23rd, 1878, must have been one of the most severe that ever visited London. A map in *British Rainfall* 1878 shows how numerous were the buildings struck by lightning within a short distance from Camden Square. Observations were made with the storm gauge, generally at half-minute intervals. From the readings the graphs reproduced above have been drawn. There were actually two storms, separated by an interval of about half-an-hour. The first storm is the one which invites attention. It will be noticed that the rate at which the rain fell was fairly steady, but that occasional bursts of greater intensity lasted a minute or two. The largest amounts which were recorded in certain intervals are shown in the accompanying table.

It is curious to notice that the highest average rate for six minutes exceeds the highest for four or five minutes. This is because the six minutes can include two minutes each with 0·17 in., the minutes beginning at 1-59 and 2-5.

It is to be borne in mind that these statistics refer to a storm

of rain not of hail: there were hailstorms on the same day in other localities, but none seem to have been reported in North London.

Rainfall Recorded at Camden Square, June 23rd, 1878.

Interval.	From.	To.	Amount.	Mean Rate.
minutes.	h. m. s.	h. m. s.	ins.	in./hr.
½	2 4 0	2 4 30	0·10	12
1	2 3 30	2 4 30	0·17	10
1½	1 59 0	2 0 30	0·26	10
2	1 59 0	2 1 0	0·32	9·6
3	1 58 0	2 1 0	0·40	8·0
4	1 57 0	2 1 0	0·47	7·0
5	1 59 0	2 4 0	0·56	6·7
6	1 59 0	2 5 0	0·73	7·3
8	1 58 0	2 6 0	0·87	6·5
10	1 55 0	2 5 0	1·04	6·2
15	1 50 0	2 5 0	1·43	5·7
20	1 46 0	2 6 0	1·82	5·5
25	1 45 0	2 10 0	2·11	5·1
28	1 44 0	2 12 0	2·30	4·9
30	1 42 0	2 12 0	2·34	4·7

The preceding table provides a standard by which reports of heavy rain can be judged. It will be admitted that the intensity reached in London on June 23rd, 1878, might be equalled occasionally in any part of the United Kingdom as every part is subject to thunderstorms. It is remarkable, however, that there are very few occasions known on which the total rainfall for any interval up to half an hour has exceeded that measured on this day. For the half-hour the largest amount on record is 2.90 inch, which was reported at Ash Hall, Cowbridge, near Cardiff, on July 22nd, 1880. The Report (*British Rainfall* 1880, p. [16]) runs :—" 2.90 inch of rain fell in 30 minutes from 1.50 to 2.20 p.m., accompanied by an immense quantity of ice in irregular-shaped pieces measuring from ½ to ¾ inch in diameter."

For a much shorter interval we have one outstanding example of rainfall estimated as being at twice the Camden Square rate. This was at Preston on August 10th, 1893. The following details were given by Mr. Sydney Wilson, an observer with 14 years' experience, in *Symons's Meteorological Magazine*, September, 1893, p. 117. "At the Corporation Offices, where I was present at the time, 2.09 in. fell in the 35 minutes, 4.5 to 4.40 p.m. After much careful thought and consideration I submit the following as showing approximately how this fall of 2.09 in. was distributed over the 35 minutes, 4.5 to 4.40 :—

4. 5 to 4.25	·70	inch
4.25 to 4.29	·04	,,
4.29 to 4.34	1·25	,,
4.34 to 4.40	·10	,,
TOTAL	2.09	inch

I consider the amount 1·25 in the five minutes, 4.29 to 4.34 p.m., well within the mark and too little, if anything . . . The excessive rain (and hail) did damage in Preston to the extent of thousands of pounds . . . At Leyland, 4 miles south, there was no rain or storm at all."

This estimate of Mr. Wilson's must be admitted, I think. It gives us 15 inches an hour as the heaviest rainfall intensity on record for this country. Whether such a rate is much exceeded in what Espy used to call "Meteoric Rivers or Waterfalls" is a question on which judgment must be reserved.

The Thunderstorm of July 22nd, 1924

By E. G. BILHAM, B.Sc.

AMONG the numerous thunderstorms which occurred during the latter part of July the disturbance of Tuesday, July 22nd, was especially noteworthy. The remarkable hailstorm which visited the London area between 13h. 30m. and 14h. G.M.T. constituted one feature of special interest; another was the fact that ball-lightning was observed during the storm both at South Kensington, London, and at Woking; a third was the exceptional intensity of the precipitation. Before discussing the theoretical aspects of the storm a summary may be given of the more interesting observations which have been received. Attention will be confined to the disturbance associated with the London hailstorm. Thunderstorms occurred during the day in numerous districts not mentioned in this article, notably in Devonshire

and Derbyshire. It is not clear, however, that they were directly associated with the London storm, and space does not permit of their further consideration.

Air Ministry, Kingsway, W.C. 2. Rain began 13h. 15m.; heavy rain and hail 13h. 25m. to 13h. 55m.; total fall during the storm 19·7 mm. (0·78 in.). Hailstones of 0·7 in. and 0·8 in. diameter were measured; cut in half the stones showed no indication of stratification, they consisted of clear ice.

Meteorological Office, South Kensington. Rain began 13h. 30m.; 28 mm. (1·10 in.) fell in 20 minutes; total fall 32 mm. (1·26 in.) in 25 minutes, a record rate of fall for that period in London. 10 mm. (0·39 in.) were observed to fall in not more than 3 minutes. Just before 14h. temperature fell abruptly from 72° F. to 58° F.

Ball lightning was observed at 14h. 5m. Three balls were seen; they were close together and appeared the size of oranges. The edges were ill-defined and "fluffy" and the colour was a glistening white. The balls were observed to pass the second storey windows of the office in a due west direction and the speed was much slower than that of a flash of lightning, in fact the balls seemed to float past. Three peals of thunder followed which were of a short, explosive character.

The microbarograph, thermograph, anemograph and recording raingauge records are reproduced in Fig. 1.

Hampstead Observatory. Between 13h. 35m. and 13h. 40m. 12·7 mm. (0·5 in.) fell; between 13h. 40m. and 13h. 45m. 7·6 mm. (0·3 in.) were measured, total fall 37 mm. (1·44 in.). At the climax of the storm 9 mm. (0·36 in.) fell in 2½ minutes.

Southgate, N. 14. Rainfall between 13h. 35m. and 15h. 38 mm. (1·5 in.). Period of greatest intensity, 14h. to 14h. 45m., accompanied by vivid lightning and thunder following the flashes immediately.

A. S. RANSOME.

Woking. "During an extremely severe thunderstorm here this afternoon ball lightning was seen. It exploded with a deafening crash on a concrete paving cracking and splitting the surface over a radius of three feet. It was visible as a glowing ball some seconds before bursting. The thunder and lightning throughout the storm were remarkably severe. The storm commenced about 3 p.m. and lasted until 5 p.m."

E. C. RUTHERFORD.

Forest Hill and Purley. "Though still raining when the train left Cannon Street at 3.45 p.m. I was surprised on looking out at Forest Hill to see everything practically dry. At Purley there had been continuous thunder about mid-day. Lander & Smith's recording thermometer showed soon after 12 o'clock a rapid fall from 73° to 59°. Yet hardly any rain fell. The total for the 24 hours of 0·03 in. included some soon after 7 p.m.

"On reaching Purley at 4.15 p.m. a halo—upper third—was just visible and a fairly bright mock sun to west, both in a filmy, homogeneous, apparently very lofty cloud layer, partly obscured by cirro-cumulus. By 4.30 p.m. the mock sun had gone, but the halo segment had brightened and continued for at least an hour. From about 5.15 p.m. the tangent arc of the great halo—itself not seen—emerged over some 10° to 15,° and by 5.30 p.m. was quite bright, though disappearing soon after."

J. EDMUND CLARK.

Guildford (*Abbotswood*). "At Abbotswood, 1¼ miles outside Guildford, during the thunderstorm on the afternoon of July 22nd there fell 59·8 mm. (2·36 in.) of rain between 14h. 57m. and 15h. 55m. (Summer Time). During the 15 years that I have taken the rain (13 years in Herts, 2 years here) I have never known any fall to equal it. The rainfall for the 24 hours taken on the morning of the 23rd was 62 mm. (2·44 in.)."

ELLIOT KITCHENER.

So far as can be seen from the data available there were three areas of heavy precipitation: (A) the Hampstead-Southgate area, (B) the Central London area, (C) the Guildford area. Between (A) and (B) falls of 18 mm. (0·7 in.) to 20 mm. (0.8 in.) occurred, but between (B) and (C) there were areas in which little or no rain fell. Thus at Kew Observatory, which lies almost exactly on a line joining areas (B) and (C) the total fall between 7h. and 18h. amounted to only 3 mm. (0·12 in.). The Abbotswood record indicates that the rainfall in the Guildford area much exceeded that

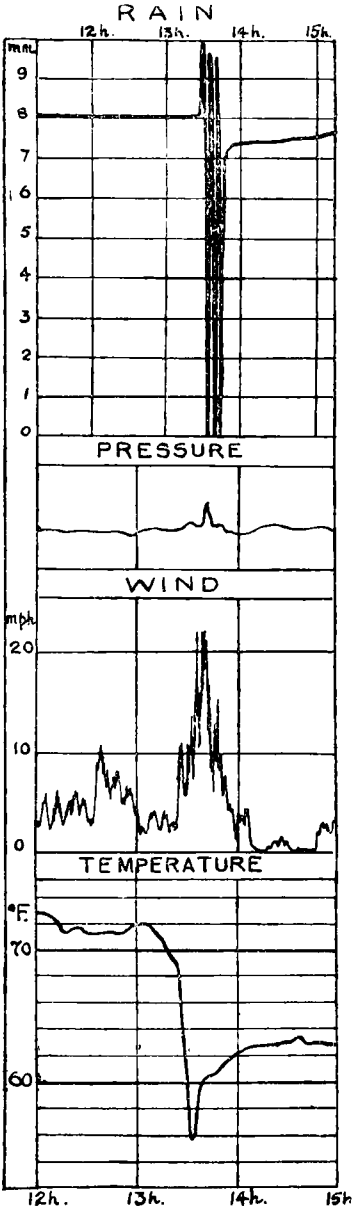


FIG. I. TRACES FROM AUTOGRAPHIC RECORDS,* SOUTH KENSINGTON, JULY 22ND, 1924.

* *N.B.*—The Pressure record is from a microbarograph.

in London. At South Farnborough, 7 miles from Guildford, 32 mm. (1·26 in.) was measured. The fall at Aldershot also seems to have been very heavy as it is stated that the lower parts of the Borough were flooded to a depth of 18 inches.

A tendency for the formation of a string of regions of heavy precipitation has been observed on some previous occasions, notably during the great rainstorm over the Quantock Hills on June 28th, 1917. Other examples can be found on reference to the volumes of *British Rainfall*. On the present occasion further records would probably result in an extension of the string south-westward, for press reports state that a "cloud-burst" occurred at Midhurst, Sussex, and a "deluge" over the western end of the Isle of Wight.*

Space permits only of a brief discussion of the origin of the storm. It was associated with the passage of a "dying" slow-moving depression over the south of England. This depression had followed an unusual track. On the morning of the 19th it was off the West Coast of Ireland, moving south-eastward. Having reached the Spanish Coast by 13h. on the 20th it turned northward and was over the English Channel on the 21st. Another centre developed over France, and the original disturbance remained nearly stationary. During the 22nd it moved slowly from southwest to northeast along a track agreeing closely with the string of areas of heavy precipitation. By 18h. it appeared as a mere bulge in the isobars over eastern England.

The wind currents were so feeble that the origin of the air supply cannot be definitely established. There was, however, a surface indraught of warm air from the Continent, resulting in temperatures of slightly over 70° F. in southeast England. An aeroplane observation over South Farnborough at 13h. 50m. disclosed a regular lapse from 63° F. at 1,890 feet to −15° F. at 20,000 feet. The dew point was 57° F., a value reached at about 3,000 feet. Above this point the lapse rate was much in excess of that for air saturated at 57° F., and in fact, approached the rate for dry air. Convectional clouds could therefore grow to great heights, and the cloud-top was in fact stated to be at 23,000 feet. The conditions were therefore extremely favourable for thunderstorms, given an initial impulse such as that provided by the warm surface current just mentioned.

* Later information shows that 3 inches of rain fell at Midhurst and 4 inches at Wisley (Surrey), and that 53 mm. (2·09 in.) were measured at Ormesby, near Gt. Yarmouth, thus extending the chain of heavy rain areas north-eastward to the Norfolk Coast.

The Question of the Permanence of Cyclone Tracks

By C. E. P. BROOKS, M.Sc.

MARSDEN MANSON, in a recent article in the *Monthly Weather Review**, shows that the present main storm track in North America coincides with the east-west watershed, and also approximately with the centres of glaciation during the Quaternary Ice Age and during the Huronian glaciation at the very beginning of the geological record. From this he infers that the track of depressions has remained practically unaltered throughout geological time, and that this is the cause of the development of the watershed referred to. The mechanism of the latter action is somewhat as follows: the earth's surface is in "isostatic equilibrium," which means that, in spite of the presence of mountain ranges and oceanic deeps, the load at a certain depth in the crust is everywhere the same. If a heavy mass is carried from one area to another, the former will rise and the latter sink, with corresponding sub-crustal movements, until equilibrium is re-established. Hence Manson supposes that the continual passage of depressions raises the earth's surface in the cyclone belt in two ways, firstly by the actual diminution of the air load, and secondly by the removal of detritus from the upper parts of the river valleys by the action of rain and snow. The first mode cited is hard to comprehend, but the second is well known to geologists, and its continuous action in the same area may result, in the absence of other disturbing factors, in the production of a low ridge cut into on either side by deep valleys.

The central part of North America consists of very old rocks, probably including remains of one of the primitive continents, and round this central core the present continent has been built up out of shore and river deposits accumulating for hundreds of millions of years. The core lay across the present main track of depressions and does seem to have been subject to intense denuding agencies, indicating heavy precipitation, throughout geological time, the losses being continually made good by isostatic elevation. This heavy precipitation may have been merely the effect of high land rising out of a warm sea, but it is equally possible that it indicates the presence of a favourite track of depressions in about 50° N throughout the history of the continent, as Marsden Manson supposes.

The principle must not be applied too rigidly, however. The North American ice-sheets certainly originated along the main

*MANSON, MARSDEN. The Physical and Geological traces of the Cyclone belt across North America. *Washington M.W. Rev., Vol.* 52, 1924, *p.* 102.

present track of depressions, so that at the beginning of the Quaternary Ice Age the belt of greatest storminess was probably near its present position, but there is considerable evidence that as the ice-sheets developed the tracks suffered a progressive shifting to the south. This seems to have been one of the reasons why the ice-sheets attained such enormous dimensions, while different centres reached their maxima at different times. The process is clearer in Europe than in America: in north-west Europe glaciation began in Scandinavia, and the area of maximum snowfall progressed south-westwards, first to Scotland and then to Ireland. The reverse process of the restoration of the present system of tracks in Europe at the close of the Ice Age can be followed very clearly†. Even as late as the Continental phase (*Ancylus* stage) of 7,000-6,000 B.C., there was still a permanent anticyclone over Scandinavia, and the shape of the sand dunes formed during this dry period indicates persistent north-westerly winds over the whole Baltic region, the normal pressure distribution resembling that now occurring during the May frosts‡. During the Ice Age the Mediterranean lands were richly watered, indicating a greatly increased frequency of depressions passing along the Mediterranean. In America the flooding of the Great Basin indicates a similar increased frequency of depressions following the southern or Arizona track during the Ice Age.

Fossil plants show that during the Tertiary period a mild equable rainy climate existed in high latitudes in at least three areas—western Greenland, western Siberia and Alaska—all of which lay then on the western shores of continental areas. This indicates that the prevailing winds in these regions were westerly or south-westerly, so that the low-pressure areas lay still further north. At this time the Arctic regions were occupied by an extensive and comparatively warm ocean, fed by three currents analogous to the Gulf Stream, and there was little or no floating ice. Under these circumstances storms would be few and of small intensity, and their tracks must have lain much further north than at present. There may have been another storm belt further south, but, so far as I know, the only evidence which can be adduced for it is a local glaciation of the San Juan Mountains of Colorado at the beginning of the Eocene period, some time before the period of optimum temperatures.

Much earlier, in Upper Permian times, there was a widespread development of arid climates, especially in parts of North

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†BROOKS, C. E. P. The Evolution of Climate in North-West Europe. *London, Q.J.R. Met. Soc., Vol.* 47, 1921, *p.* 173.

‡HOGBOM I. Ancient inland dunes of northern and middle Europe. *Stockholm, Geog. Ann. Vol.* 5, 1923, *p.* 113.

America and Europe which at present have a considerable rainfall, derived from passing depressions.

Manson's hypothesis of the permanence of storm tracks is based mainly on one great generalisation, supported by a few isolated facts. I have quoted other facts which point to a different conclusion, but I am not prepared to reject the hypothesis entirely without a much fuller study of the climatic conditions of the different epochs. I think the most that can be claimed is that the storm tracks have swung north and south with the varying physical geography of the earth, and that at present the tracks occupy more or less their average position.

OFFICIAL NOTICE

In consequence of the retirement from the Service of the Meteorological Office of Dr. A. Crichton Mitchell, the following changes are announced to take place on October 1st, 1924. Major A. H. R. Goldie, Superintendent of the Local Centres Division, will succeed Dr. Crichton Mitchell as Superintendent of the Meteorological Office at Edinburgh. Captain F. Entwistle, Superintendent of the Instruments Division, will become Superintendent of the Local Centres Division, and Mr. E. G. Bilham, Assistant Superintendent in the Forecast Division, will be promoted Superintendent of the Instruments Division.

OFFICIAL PUBLICATIONS

The following publications have recently been issued :—

PROFESSIONAL NOTES—

No. 34. *How to observe the Wind by Spheres shot upwards.* By L. F. Richardson, B.A., F.Inst.P. (M.O. 245n.)

The general method consists in shooting upwards small steel spheres in such a way that the pressure of the wind upon a sphere in its trajectory brings it back to the starting point when it returns to earth. The small angle by which the gun has to be deflected from the vertical to get this result gives a measure of the wind aloft, and, by determining this angle for gradually increasing times of flight, values of wind velocity and direction in successive layers of the atmosphere are found. The method is likely to prove especially valuable when the weather is foggy and pilot balloons therefore cannot be observed.

RÉSEAU MONDIAL 1915. Part V. of the British Meteorological and Magnetic Year Book 1915. (M.O. 222g.)

Royal Meteorological Society

A SUMMER meeting of the Society was held by invitation of the Director, Sir John Russell, F.R.S., at the Rothamsted Experimental Station, Harpenden, on Friday, July 18th. In the morning the party visited the classical field plots, the meteorological station and the drainage gauges, and interesting particulars relating to each were given by the Station staff. In the afternoon papers were read and discussed, and after tea the laboratories were inspected. A vote of thanks to the Rothamsted authorities, proposed by Mr. C. J. P. Cave, President of the Society, was responded to by Dr. B. Keen, Assistant Director of the Station, who presided in the unavoidable absence of the Director.

The following papers were read:—

R. A. Fisher, M.A.—Adaptation of Variety to Climate.

One of the main problems attacked by the statistical laboratory at Rothamsted in recent years has been to ascertain numerically the effect of weather on the yield of farm crops. The Rothamsted data give the yield of wheat on thirteen plots which have been under uniform manurial treatment since 1851, and rain records from a large gauge set up in 1853. From these series of values it has been possible to evaluate the actual gain or loss of each crop consequent upon an additional inch of rain at any time during the harvest year. A comparison of the different response of the different plots to rainfall shows the possibility of the farmer adapting his manurial treatment to season and to climate, especially in relation to nitrogenous fertilisers. The work has involved a detailed analysis of the distribution of rainfall through the year for each year since 1853, some of the results of which are of interest. The annual rainfall fluctuations are not at haphazard, but at two periods, centred about 1879 and 1914, there were prolonged spells of significantly increased rainfall. There is also evidence to show that Decembers are becoming increasingly wet.

In the discussion reference was made to the relation between autumnal rainfall and subsequent yield of wheat, formulated by Sir Napier Shaw for eastern England,* and to the fact that this relation did not hold for the Rothamsted plots. This might be because, at Rothamsted, wheat was grown on the plots every year without intermission, whereas the actual yield of wheat in eastern England must depend partly on the area sown, which, in turn, depends partly on the autumn rainfall, because in a wet season it is impossible to prepare the ground for the crop.

W. B. Haines, B.Sc.—A comparison of the readings taken at Rothamsted with three types of radiation recorders.

This paper deals with a comparison of the readings taken at

* *Proc. Roy. Soc., Vol.* 78 (*series A*), 1906, *p.* 69.

Rothamsted with three types of radiation recorder, viz., the Callendar instrument, taken as standard, the Wilson radio-integrator, and the Campbell-Stokes sunshine recorder. Reference is also made to a fourth set of data, that given by an evaporimeter of the porous candle type. A diagram made by plotting the data to suitably adjusted units brings out the following points: (1) The Wilson integrator gives readings much too low during the winter months; (2) The hours of bright sunshine should be corrected by a factor depending upon the time of day and year (*i.e.*, upon the sun's altitude). A formula deduced by Ångström from the Stockholm data, for calculating total radiation from hours of bright sunshine, is examined and found fairly satisfactory for the Rothamsted data. The evaporimeter results follow the hours of sunshine very closely, but some care is needed in the choice of a site for this instrument.

Correspondence

To the Editor, *The Meteorological Magazine*

The Boundary Between Calms and Neighbouring Breezes

THE following observation may be of interest. On the evening of May 4th (18h. local time) it was observed that, as frequently occurs, a large portion of the sea was dead calm while the rest was covered with ripples. Sailing boats on one side of the boundary between the two areas had a southerly breeze off the land, of about force 2; while on the other side they had no breeze at all. At the same time a steamer was leaving Malta, and was emitting heavy smoke. For about two miles to leeward the smoke drifted along the sea surface with very little dissipation, but on reaching the boundary between the calm and rippled areas, it rose at an angle of between 30° and 40° to a height of about 200 feet. Thereafter it continued to move in the same direction until it was lost in the distance, remaining at a constant height of about 200 feet, but becoming much more diffuse.

This is presumably a case of warm air rising over an inert mass of cool air, and, under the right conditions, it could evidently give rise to low cloud formation, or to fog bank.

It would be interesting to learn whether any direct observations have been made at the boundaries of local gusts. It seems possible that the patches of disturbed water in gusty winds may be caused by the converse process: a sort of progressive cascade of rapidly moving air. The remark has often been made that

some winds " bear more heavily " on the water than others, and, for the same velocity, raise a much higher sea. No doubt some types of turbulence consist chiefly of localised descending currents and diffuse ascending currents, while others consist of localised ascending currents and diffuse descending currents. One might expect, for example, a wind in which cold upper air is overtaking surface air in contact with a warm sea to show localised descending currents. If such descending currents are more characteristic of winter than of summer, the relative " heaviness " of winter gusts, as noticed by sailing boats in the Mediterranean, would be accounted for, since a descending current would become more nearly normal to the sail surface as the boat heeled to the gust. In summer, the majority of local gusts may, like those of dust devils, consist of ascending air.

W. A. HARWOOD.

Meteorological Office, Pieta, Malta, July 23rd, 1924.

Halo at Waringstown

I HAVE read with much interest, Mr. G. A. Clarke's account of an elliptic halo in the July issue of the *Meteorological Magazine,* and would like to place before your readers an observation of my own. At 11h. G.M.T. on April 27th, 1923, the southern sky was covered with cirrus haze, wind south-east. At 11h. 15m. a brilliant halo of about 20° was in evidence around the sun and perfect in structure throughout but absolutely without any prismatic tints. At 11h. 30m. an upper arc of contact but bent downwards appeared conjointly at the " 12 o'clock " point of the halo of 20°. Shortly afterwards a lower arc appeared at the " six o'clock " point, arms bent upwards, and meeting the arms of the upper arc, joined together forming a large " bulge " outside the principal halo. The ellipse was highly coloured with orange, fading to bluish green. The phenomenon remained visible for about an hour and 10 minutes. Hail showers fell in the evening giving a total when thawed of 0·11 inches.

W. J. GIBSON.

The Forge, Waringstown, Co. Down, July 19th, 1924.

The Reform of the Calendar

SEEING that you have introduced into your July number the question of a Reformed Calendar, will you allow a mere amateur to support your objection to a 13 months' scheme, which would give us neither half years nor quarters ; and to object further to the " odd day," a " Dies non " I presume, which that scheme would entail. What could an unfortunate observer do with it either for his totals or his averages ?

The perfect calendar will not be possible to man till he can control the orbit of the earth itself. As yet we must submit to a course of nature in which nothing does fit exactly. Astronomical periods are incommensurate one with another. Days do not fit with the lunar months : and neither days nor solar months fit with solar years. The history of the Calendar is that of a slow struggle, for thousands of years, to discover and adjust the small misfittings.

We owe much to the reformation of the Calendar carried through under Julius Cæsar, with months alternately of 31 and of 30 days, although his consistent plan was badly marred by the vanity of Augustus, who, that he might have 31 days for the month to which he gave his name, interchanged the thirty-firsts and the thirtieths in all the months from August to December.

Seeing, however, that in ordinary years of 365 days there are but 5 spare days over and above 12 × 30, it would have been better if the first month had had 30 days, the second 31, and so on alternately, the twelfth month getting 31 days in Leap Year only. No nearer approach to uniformity is possible if the 12 months are to embrace the whole year.

If, again, the months were themselves shifted by 10 days, so that each quarter of the year might begin as nearly as possible coincidently with the four Solar Epochs, *i.e.*, the Summer and Winter Solstices and the Vernal and Autumnal Equinoxes, then there would be a Calendar resting on a sound Astronomical basis, suitable for every nation and every climate.

It might probably be found best to begin the year either at the Vernal Equinox with a thirty day April, or at the Autumnal Equinox with a thirty day October. In any case the extra day of Leap Year should be the last day of the year.

H. A. BOYS, F.R.Met. Soc.

Spring Hill, St. Mary Bourne, July 23rd, 1924.

NOTES AND QUERIES

The School of Meteorology

THE retirement of Sir Napier Shaw from the Professorship of Meteorology at the Imperial College of Science and Technology is announced to take place on August 31st, 1924. An account of his life and work up to 1920 will be found in the *Meteorological Magazine* for September, 1920. Since then he has devoted himself to the development of the teaching of meteorology in this country both as a pre-graduate and post-graduate course with a view to making the School of Meteorology a centre of research for students of all nationalities. The School has also undertaken the training of R.A.F. Officers for meteorological work in the Middle East. During the four years he has found

time in the midst of his duties as Professor and as President of the International Meteorological Committee to publish *The Air and its Ways*, one of the most valuable contributions to meteorology in recent years, a new and enlarged edition of *Forecasting Weather* and numerous other papers. After he leaves the School, Sir Napier hopes to continue his work on the *Manual of Meteorology*, of which Part IV. was published in 1919.

Sir Gilbert Walker, whose retirement from the Office of Director-General of Indian Observatories was noted in the July issue of this Magazine, has been appointed as his successor.

Radiation from the Sky

RADIATION MEASURED AT BENSON, OXON, 1924.

Unit: one gramme calorie per square centimetre per day.

ATMOSPHERIC RADIATION only (dark heat rays).

Averages for Readings about time of Sunset.

		April.	May.	June.
Cloudless days:—				
Number of readings	n	7	No observations	12
Radiation from sky in zenith ...	π I	545		576
Total radiation from sky ...	J	579		616
Total radiation from horizontal black surface on earth ...	X	731		764
Net radiation from earth ...	X—J	152		148

DIFFUSE SOLAR RADIATION (luminous rays).

Averages for Readings between 9 h. and 15 h. G.M.T.

Cloudless days:—				
Number of readings	n_0	2	No observations	2
Radiation from sky in zenith ...	πI_0	30		40
Total radiation from sky ...	J_0	30		39
Cloudy days:—				
Number of readings	n_1	2		3
Radiation from sky in zenith ...	πI_1	63		115
Total radiation from sky ...	J_1	58		104

Unit for I = gramme calorie per day per steradian per square centimetre.

Unit for J and X = gramme calorie per day per square centimetre.

For description of instrument and methods of observation, see *The Meteorological Magazine*, October, 1920, and May, 1921.

The Norwegian Meteorological Service

THE tragic story of the ships carrying on the Norwegian Meteorological Service in the Arctic was related by Dr. Simpson in the *Meteorological Magazine* last December. It will be remembered that one of the ships, the "Annie," left Mygbugten last July, and that when search was being made for her towards the end of the year the relief ship foundered in a storm. Shackleton's old ship, the "Quest," has now taken up the dangerous task and left Patricksfjord, Iceland, on July 8th for Angmagsalik, Greenland. At Angmagsalik the "Quest" will find the crew of the Danish ship "Teddy," which has been fast in the ice off the Greenland coast for thirteen months and which was found by a Norwegian whaler a little time ago. It is hoped that the "Annie" may likewise be found in the ice. It is true that, being equipped with wireless, she should have been able to communicate with the world but there is a possibility that the wireless apparatus may have broken down though the ship is safe.

Typhoon at Hong Kong

The Marine Observer for August, 1924, contains details of the history of the "Hong Kong Typhoon, August 18th, 1923." There were three ships in the track of the centre of this typhoon so that the variations of the diameter of the calm area, the "eye of the storm," could be followed. On the 16th this diameter was about 28 miles. On the 18th when the storm was approaching Hong Kong it had diminished to 7 miles. The transition from the region of hurricane winds into the calm was then quite sudden.

The centre of the storm passed 14 miles to the south of Hong Kong observatory. The autographic records, which are reproduced in the *Marine Observer*, show remarkable symmetry. The highest gust is shown by the record from the Dines anemograph as 130 miles per hour. This is, we believe, the greatest wind speed ever recorded autographically, and it is to be hoped that the instrument will be tested so that the estimate can be verified. The recorder is not usually calibrated up to 130 miles per hour. Between 4h. and 10h. 20m. on August 18th the average wind speed at the observatory increased from 12 miles an hour to 83 miles an hour whilst the distance of the centre of the typhoon decreased from 93 miles to 14 miles. It is of great interest to notice that the product of speed and distance remained practically constant during this time.

The general uniformity of temperature at Hong Kong during the episode is perhaps more remarkable than a curious temporary drop of 2° F. which occurred shortly after the passage of the worst of the gale.

Gale Warnings Issued by the Meteorological Office

A STORM which developed rapidly on Thursday, July 17th, affords a good example of the help which the gale warning service of the Meteorological Office can give to those responsible for the navigation of small craft in British Coastal Waters and in the North Sea. A long spell of fair, quiet weather had prevailed up to the 17th of the month, but in the early hours of that day a " secondary " depression was shown by the weather reports from Ireland to be approaching from the Atlantic. During the morning it became evident that the secondary depression was increasing in intensity, and, after the 2 p.m. readings were received at the Meteorological Office, gale warnings were issued to the gale warning stations along the shores of the eastern part of the English Channel and the southern North Sea, and the following message was sent out from the Radio stations at Lands End and Niton: " Gale warning SW to W, force 7 to 8 expected southern coasts Start Point to Harwich." Gale warnings are issued on 600 metre wavelength preceded by the International Safety Signal T.T.T. immediately upon receipt at Radio stations.

The wind at the time at which the warning was issued on the 17th was of moderate force in the Straits of Dover and light over the southern North Sea. This condition persisted for 4 or 5 hours afterwards in the Straits and rather longer in the southern North Sea. Then the wind rose rapidly during the evening, and high winds or gales were experienced at night over the area, at first from south or south-west changing suddenly to north-west.

Many lives were lost on the Dutch and Belgian coasts, of fishermen who presumably had gone out of sight of coast warnings without any means of receiving wireless messages, and were in consequence caught unprepared.

Atlas Pluviometrico do Nordéste do Brasil

The rainfall Atlas recently published for the extreme north-eastern part of Brazil by the Inspectoria Federal de Obras contra as Seccas contains a series of five maps giving the annual fall, the driest and wettest years, and the months of greatest and least fall for the period 1912-1920. It is interesting to note that the maps for 1914-15 and 1916-17, the driest and wettest years respectively, are complementary, the extreme values being in the north in each case,while the south showed the least deviation.

Artificial Lightning

THE results of some interesting experiments on high voltage phenomena carried out by Mr. F. W. Peek of the General Electric Company, are discussed in a paper* published recently in the

* *Philadelphia Pa. J. Frank, Inst.* Vol. 197, Jan. 1924, p. 1.

Journal of the Franklin Institute. The experiments were undertaken primarily with a view to improving the design of the insulators used on power transmission lines. Gaps between needle points were so arranged that voltages up to nearly 2,000,000 volts had to be applied, if the voltage were applied impulsively, before the " spark-over " occurred. It was found that, whereas in the case of needle point gaps the voltage when applied impulsively was approximately twice as great as the continuously applied voltage necessary to produce sparking, with spheres there was little difference in " spark-over " voltage whether applied impulsively or continuously. The experiments proved that the ratio of the length of the gap to the " spark-over " voltage for high voltages is the same as that found for comparatively low voltages.

We, as meteorologists, are concerned more particularly with the application of these experiments to the problem of lightning discharges. Mr. Peek reproduced in miniature the electrical conditions believed to exist during a thunderstorm. He introduced near the ground insulated wires corresponding with power transmission wires in the open, and found that with a model representing a charged cloud at 860 feet the voltage statically induced on the insulated wire at the moment the cloud discharged was approximately 2 per cent. of the voltage producing the lightning flash. He estimates that in nature the voltage induced in a power transmission line by a cloud at 1,000 ft. discharging to earth would be of the order of 1 per cent. of the cloud-earth voltage. Induced voltages on transmission lines of the order of 1,000,000 volts have been measured during thunderstorms. It is deduced therefore that the voltage causing a severe lightning flash to earth may be about 100,000,000 volts.

Review

An Introduction to Forecasting Weather. By RAYMOND ZEALLEY, F.R. Met. Soc. $7\frac{1}{2} \times 5\frac{1}{2}$, pp. 32. *Illus.* Cambridge : Heffer, 1922. Price 1/- net.

This attractive little book represents the jottings in the notebook of the practical man who is becoming acquainted with the technical terms used in the forecaster's office. You can see at a glance which way a cyclone spins in either hemisphere, what is the difference between " backing " and " veering " winds or how a nascent secondary shows itself on the map. We can hardly agree with the author in giving the title " Typical Example of Strato-Cumulus " to the frontispiece.

Obituary

Frank Hagar Bigelow.—Professor Bigelow, whose death at Vienna was announced in the May number of the *Meteorological Magazine,* was born at Concord, Mass., U.S.A., in 1851. After graduating at Harvard he spent some years at the Cordoba Observatory in Argentina as an astronomer, held a professorship of mathematics in Racine College, and subsequently was assistant in the Nautical Almanac Office at Washington. In 1891 he became Minister of St. John's, Washington, and was also appointed professor of meteorology in the U.S. Weather Bureau, both of which charges he maintained until 1910 when he again returned to Argentina, being at first engaged in special researches on evaporation at Cordoba, and latterly (from 1916 to 1921) as Director of the neighbouring magnetic observatory at Pilar.

Bigelow's books and memoirs covered a wide field. Among the most important may be mentioned a large work on the barometric pressure of the United States, an elaborate monograph on *Eclipse Meteorology and Allied Problems,* and several important papers dealing with the relations of solar conditions to terrestrial weather and magnetism. He is known to meteorologists for his great report on the cloud observations made all over the globe in the years 1896 and 1897. From 1910 onwards he was specially engaged in devising a simple adjustment of the thermodynamic adiabatic equations to an exact and practical form of computation which would adapt them to the non-adiabatic system prevailing in the solar and terrestrial atmosphere. Towards this provision of a " reformed meteorology " Professor Bigelow wrote two books, *Atmospheric Circulation and Reduction* 1915, and a *Treatise on the Sun's Radiation* 1918, addenda in the form of five supplements appearing at intervals between 1919 and 1923. Failing eyesight induced him to resign his Argentine post in 1921 but he continued his labours in Vienna, where he made his home. It is not easy to form an exact estimate of the value of Professor Bigelow's later work, but there is no doubt that he spared neither time, money, nor health in a sustained endeavour to place his " case " before his meteorological colleagues. It is to be hoped that some competent person will have the patience to examine the material and let the world know whether there is " anything in it."

News in Brief

Mr. E. A. Milne, assistant director of the Solar Physics Observatory at Cambridge, has been appointed to the Beyer Chair of Applied Mathematics at Manchester.

The Weather of July, 1924

THE most striking features of the weather of the month were the severe local thunderstorms and general heavy rains. During the first week low pressure prevailed to the west and north of the British Isles, and secondary depressions passing across the country in a north-easterly direction caused generally cool and unsettled weather, with rainfall above the weekly average except in the south-eastern districts of England. Thunderstorms were widespread in England and Ireland on the 3rd and 4th and gales occurred at exposed places in the south on the 3rd. On the 9th the high pressure area to the south spread northwards over Great Britain and the North Sea and a spell of fine warm weather set in over the country generally, though owing to the low pressure area which still prevailed to the north-west conditions on the west coasts of Ireland and Scotland remained unsettled. Temperature rose gradually until the 12th, which was the hottest day of the year in most districts, the highest temperatures recorded for England, Scotland and Ireland on that day being 90° F. at Camden Square, London, 81° F. at Fort Augustus and 74° F. at Dublin. The spell of fine weather, however, broke on the 17th, an intense secondary depression passing eastwards across southern England, causing heavy rain and local gales in the south. From then until the end of the month the weather was cool and unsettled and depressions passing across the southern districts caused heavy local rains and numerous thunderstorms. Two severe thunderstorms occurred in London, one on the 22nd, a description of which will be found on p. 152, and one on the 29th. During the latter storm the rainfall varied considerably, *e.g.*, only 3 mm. were measured at South Kensington, while Hampstead had 54 mm. Many of the thunderstorms in the other parts of the country were also accompanied by heavy rain. The heaviest rainfall in a single day of the month, 103 mm. (4·1 in.), occurred at Wisley (Surrey) on the 22nd. Other notable falls were 74 mm. (2·9 ins.) at Falmouth in the 24 hours ending midnight on the 21st, which is the largest amount ever recorded there for a similar period, 64 mm. (2·5 ins.) at Brushford, Somerset, on the 20th, and 64 mm. (2·5 ins.) at Douglas (Isle of Man) on the 28th. At Hampstead the July rainfall total 193 mm. (7·6 ins.) was the largest recorded in any month since observations began there in 1858. The nearest approach was 180 mm. (7·1 ins.) in October, 1865.

Western Europe had mainly fine weather during the first half of the month, with some very hot days, especially in Paris on the 14th. Castile and Andalusia were suffering from prolonged drought, no rain having fallen for nearly four months. Drought also prevailed in southern Russia, but north and north-west Russia was suffering from prolonged cold and rainy weather,

and on the 1st severe storms caused floods in the northern Tyrol. The second half of the month was exceptionally stormy over the whole of Europe. On the 18th a heavy gale off the Belgian and Dutch coasts caused considerable loss of life. There were numerous thunderstorms in Switzerland, culminating on the 23rd. This was followed on the 27th by a sharp fall of temperature in Switzerland and northern Italy, snow falling as low as 4,000 feet. On the 22nd heavy rains were reported from Tolosa (northern Spain), and on the 30th another severe thunderstorm visited Brussels and Ghent, where considerable damage was done by lightning.

In India the monsoon rains were generally good, and in the south were very heavy, especially in Cochin and Travancore. The river Cauvery rose to 34½ feet above its usual level at Erode, and thousands of houses have been swept away, with much loss of life. The Coleroon river (south of Pondicheri) is also in flood. Owing to the breaking down of bridges railway communication has ceased. On the 25th it was reported that Bombay Presidency was threatened with drought, but very heavy rain fell at Ahmedabad on the 29th. In China the floods are even more serious, and the previous high water mark of 1917 has been exceeded. In the province of Chih-li the flooded area exceeds 10,000 square miles, and at least a million people are homeless. The port of Tientsin is in great danger. Great floods are also reported from Ho-nan (central China) where about a million people are homeless. By the 21st the July rainfall in North China had exceeded 20 inches, and rain was still falling in heavy showers. The normal for the month is about 7 inches.

In North America, after the hurricane at the end of June, conditions have been rather quiet. In Canada hot dry weather during the first half of the month threatened drought in the agricultural districts round Winnipeg, but on the 16th a depression following a rather northerly track brought good rains.

The special message from Brazil states that the rainfall over the whole country was small, being 21 mm., 10 mm. and 35 mm. below the normal in the northern, central and southern districts respectively. Well developed anticyclones continued to cross the country, but were often interrupted by areas of low pressure. The weather was generally favourable for wheat but not so good for the other crops. Pressure at Rio de Janeiro was 1·7 mb. above normal and temperature 2° F. above normal.

Rainfall July, 1924: General Distribution

England and Wales	152	per cent. of the average 1881-1915.
Scotland	152	
Ireland	132	
British Isles	149	

Rainfall: July, 1924: England and Wales.

CO.	STATION.	In.	mm.	Per-cent. of Av	CO.	STATION.	In.	mm	Per-cent. of Av.
Lond.	Camden Square.....	5·69	145	239	*War.*	Birminghm, Edgbaston	3·28	83	141
Sur .	Reigate, Hartswood...	4·18	106	199	*Leics*	Leicester Town Hall...	2·47	63	...
Kent.	Tenterden, View Tower	3·26	83	156	,, .	Belvoir Castle.....	2·35	60	97
,,	Folkestone, Boro. San.	3·51	89	...	*Rut .*	Ridlington.....	3·10	79	...
,,	Broadstairs	...	...	...	*Linc.*	Boston, Skirbeck	1·97	50	90
,, .	Sevenoaks, Speldhurst.	4·10	104	...	,, .	Lincoln, Sessions House	1·71	43	77
Sus .	Patching Farm.....	3·67	93	153	,, .	Skegness, Estate Office.	...	...	...
,, .	Eastbourne, Wilm. Sq.	2·61	66	119	,, .	Louth, Westgate	2·42	61	97
,, .	Tottingworth Park....	4·60	117	184	,, .	Brigg	2·13	54	91
Hants	Totland Bay, Aston...	3·15	80	164	*Notts.*	Worksop, Hodsock....	2·01	51	89
,, .	Fordingbridge, Oaklnds	4·26	108	213	*Derby*	Mickleover, Clyde Ho..	3·09	79	126
,, .	Portsmouth, Vic. Park.	2 62	67	128	,, .	Buxton, Devon. Hos...	5·37	136	137
,, .	Ovington Rectory	4·81	122	186	*Ches.*	Runcorn, Weston Pt...	4·44	113	161
,, .	Grayshott	4·35	110	178	,, ..	Nantwich, Dorfold Hall	4·27	109	...
Berks	Wellington College...	3·87	98	187	*Lancs*	Bolton, Queen's Park .	4·68	119	...
,, .	Newbury, Greenham..	...	...	...	,, ..	Stonyhurst College....	5·26	133	136
Herts.	Bennington House....	4·42	112	181	,, ..	Southport, Hesketh...	4·28	109	150
Bucks	High Wycombe	5·41	137	275	,, ..	Lancaster, Strathspey.	3·39	86	...
Oxf..	Oxford, Mag. College..	3·47	88	153	*Yorks*	Sedbergh, Akay	5·39	137	120
Nor .	Pitsford, Sedgebrook..	2·92	74	124	,, .	Wath-upon-Dearne ...	2·29	58	91
,, .	Eye, Northolm.....	3·17	81	...	,, .	Bradford, Lister Pk...	3·40	86	124
Beds.	Woburn, Crawley Mill.	3·06	78	130	,, .	Oughtershaw Hall	6·96	177	...
Cam.	Cambridge, Bot. Gdns.	...	...	...	,, .	Wetherby, Ribston H..	3·66	93	146
Essex	Chelmsford, CountyLab	3·43	87	...	,, .	Hull, Pearson Park ...	2·99	76	120
,, .	Lexden, Hill House...	3·21	81	...	,, .	Holme-on-Spalding ...	2·90	74	...
Suff .	Hawkedon Rectory ...	3·41	87	140	,, .	Lowthorpe, The Elms.	4·05	103	177
,, .	Haughley House.....	2·68	68	...	,, .	West Witton, Ivy Ho..	...	...	...
Norf.	Beccles, Geldeston....	2·29	58	98	,, .	Pickering, Hungate ...	3·58	91	...
,, .	Norwich, Eaton	...	...	...	,, .	Middlesbrough	3·61	92	141
,, .	Blakeney	1·75	44	77	,, .	Baldersdale, Hury Res.	4·53	115	146
,, .	Swaffham	1·90	48	74	*Durh*	Ushaw College	4·16	106	149
Wilts.	Devizes, Highclere....	3·85	98	166	*Nor .*	Newcastle, Town Moor.	4·26	108	161
Dor .	Evershot, Melbury Ho.	4·64	118	183	,, .	Bellingham Manor....	4·66	118	...
,, .	Weymouth, Westham..	3·49	89	194	,, .	Lilburn Tower Gdns...	5·25	133	...
,, .	Shaftesbury, Abbey Ho.	3·71	94	144	*Cumb*	Penrith, Newton Rigg..	...	...	...
Devon	Plymouth, The Hoe...	5·01	127	180	,, .	Carlisle, Scaleby Hall .	3·90	99	119
,, .	Polapit Tamar	4·13	105	153	,, .	Seathwaite	11·45	291	135
,, .	Ashburton, Druid Ho..	5·97	152	196	*Glam.*	Cardiff, Ely P. Stn....	5·91	150	190
,, .	Cullompton	4·30	121	160	,, .	Treherbert, Tynywaun	8·97	228	...
,, .	Sidmouth, Sidmount ..	3·89	110	155	*Carm*	Carmarthen Friary....	5·43	138	155
,, .	Filleigh, Castle Hill ...	4·99	127	...	,, .	Llanwrda, Dolaucothy	6·76	172	156
,, .	Hartland Abbey... ..	4·55	116	...	*Pemb*	Haverfordwest, Portf'd	...	...	...
Corn.	Redruth, Trewirgie ...	4·02	102	132	*Card.*	Gogerddan.....	5·78	147	150
,, .	Penzance, Morrab Gdn.	3·77	96	139	,, .	Cardigan, County Sch. .	5·69	145	...
,,	St. Austell, Trevarna..	6·25	159	187	*Brec .*	Crickhowell, Talymaes	6·00	152	...
Soms	Chewton Mendip	4·83	123	138	*Rad .*	Birm. W. W. Tyrmynydd	6·45	164	157
,, .	Street, Hind Hayes ...	3·19	81	...	*Mont.*	Lake Vyrnwy	7·51	191	219
Glos..	Clifton College	5·31	135	188	*Denb.*	Llangynhafal	3·94	100	...
,, .	Cirencester	4·65	118	175	*Mer .*	Dolgelly, Bryntirion..	6·99	177	164
Here.	Ross, County Obsy. ...	4·10	104	182	*Carn.*	Llandudno	3·66	93	153
,, .	Ledbury, Underdown.	4·22	107	187	,, .	Snowdon, L. Llydaw 9	13·20	335	...
Salop	Church Stretton.....	5·36	136	219	*Ang .*	Holyhead, Salt Island.	3·64	92	139
,, .	Shifnal, Hatton Grange	4·67	119	208	,, .	Lligwy	...	...	...
Staff.	Tean, The Heath Ho...	4·59	117	158	*Isle of Man*				
Worc.	Ombersley, Holt Lock.	3·43	87	160		Douglas, Boro' Cem...	5·76	146	188
,, .	Blockley, Upton Wold.	3·90	99	160	*Guernsey*				
War.	Farnborough.....	3·36	85	131		St. Peter Port Grange.	2·77	70	137

Rainfall: July, 1924: Scotland and Ireland

CO.	STATION	In.	mm.	Per-cent. of Av.	CO.	STATION.	In.	mm	Per-cent of Av.
Wigt.	Stoneykirk, Ardwell Ho	4·31	109	149	*Suth.*	Loch More, Achfary...	6·20	157	116
,, .	Pt. William, Monreith.	4·21	107	...	*Caith*	Wick	3·86	98	147
Kirk.	Carsphairn, Shiel.	6·52	166	...	*Ork .*	Pomona, Deerness	2·56	65	100
,, .	Dumfries, Cargen.....	4·93	125	152	*Shet .*	Lerwick	4·00	101	175
Dum	Drumlanrig	5·40	137	158					
Roxb	Branxholme	4·78	121	158	*Cork.*	Caheragh Rectory	6·92	176	...
Selk .	Ettrick Manse.....	6·50	165	...	,, . .	Dunmanway Rectory.	6·94	176	178
Berk.	Marchmont House	5·76	146	189	,, . .	Ballinacurra	4·09	104	147
Hadd	North Berwick Res....	4·00	102	155	,, . .	Glanmire, Lota Lo. ...	4·31	109	149
Midl	Edinburgh, Roy. Obs..	4·22	107	162	*Kerry*	Valencia Obsy.	5·53	140	146
Lan .	Biggar	4·48	114	154	,, .	Gearahameen	5·20	132	...
Ayr .	Kilmarnock, Agric. C..	3·56	90	114	,, .	Killarney Asylum.....	3·65	93	110
,, .	Girvan, Pinmore.....	3·51	89	96	,, .	Darrynane Abbey	4·12	105	108
Renf.	Glasgow, Queen's Pk..	...	...	...	*Wat .*	Waterford, Brook Lo..	...	...	...
,, .	Greenock, Prospect H..	4·16	106	106	*Tip .*	Nenagh, Cas. Lough...	3·49	89	111
Bute.	Rothesay, Ardencraig.	5·96	151	150	,, .	Tipperary	2·81	71	...
,, .	Dougarie Lodge	4·89	124	...	,, .	Cashel, Ballinamona ..	3·27	83	113
Arg .	Glen Etive.....	...	...	...	*Lim .*	Foynes, Coolnanes	2·66	67	86
,, .	Oban	6·20	157	...	,, .	Castleconnell Rec.	3·19	81	...
,, .	Poltalloch	6·92	176	169	*Clare*	Inagh, Mount Callan ..	6·69	170	...
,, .	Inveraray Castle.....	7·23	184	145	,, .	Broadford, Hurdlest'n.	4·76	121	...
,, .	Islay, Eallabus.....	5·68	144	167	*Wexf*	Newtownbarry	3·66	93	...
,, .	Mull, Benmore	18·20	462	...	,, .	Gorey, Courtown Ho...	4·59	117	156
Kinr.	Loch Leven Sluice	5·73	145	199	*Kilk.*	Kilkenny Castle	3·30	84	117
Perth	Loch Dhu	8·00	203	166	*Wic .*	Rathnew, Clonmannon	4·01	102	...
,, . .	Balquhidder, Stronvar.	7·07	180	164	*Carl .*	Hacketstown Rectory .	4·02	102	117
,, . .	Crieff, Strathearn Hyd.	4·67	119	157	*QCo..*	Blandsfort House.....	3·57	91	114
,, . .	Blair Castle Gardens ..	4·73	120	...	,,	Mountmellick	3·97	101	...
,, .	Coupar Angus School..	4·53	115	192	*KCo.*	Birr Castle.....	2·95	75	100
Forf.	Dundee, E. Necropolis.	4·74	120	173	*Dubl.*	Dublin, FitzWm. Sq...	3·59	91	140
,, .	Pearsie House.....	5·82	148	...	,, .	Balbriggan, Ardgillan .	3·56	90	131
,, .	Montrose, Sunnyside..	4·53	115	221	*Me'th*	Drogheda, Mornington	3·57	91	...
Aber.	Braemar Bank	4·30	109	168	*W.M*	Mullingar, Belvedere .	5·18	132	163
,, .	Logie Coldstone Sch. ..	5·52	140	186	*Long*	Castle Forbes Gdns....	4·14	105	133
,, .	Aberdeen, Cranford Ho	6·59	167	223	*Gal .*	Galway, Waterdale ...	...	...	...
,, .	Fyvie Castle	3·05	77	...	,, .	Ballynahinch Castle ..	6·95	177	...
Mor .	Gordon Castle.....	3·20	81	100	*Mayo*	Mallaranny.....	6·15	156	...
,,	Grantown-on-Spey....	4·39	111	143	,, .	Westport House.....	4·47	113	144
Na .	Nairn, Delnies.....	3·43	87	128	,, .	Delphi Lodge	9·73	247	...
Inv..	Ben Alder Lodge	5·59	142	...	*Sligo*	Markree Obsy.	4·64	118	135
,, .	Kingussie, The Birches	3·69	94	...	*Ferm*	Enniskillen, Portora ..	3·86	98	...
,, .	Fort Augustus	4·08	104	146	*Arm.*	Armagh Obsy.	4·77	121	165
,, .	Loch Quoich, Loan....	12·00	305	...	*Down*	Warrenpoint	4·71	120	...
,, .	Glenquoich	10·22	260	159	,, .	Seaforde	5·68	144	178
,, .	Inverness, Culduthel R.	3·22	82	...	,, .	Donaghadee	3·19	81	114
,, .	Arisaig, Faire-na-Squir	5·61	143	...	,, .	Banbridge, Milltown .	3·94	100	121
,, .	Fort William.....	8·58	218	...	*Antr.*	Belfast, Cavehill Rd. ..	3·91	99	...
,, .	Skye, Dunvegan.....	4·79	122	...	,, .	Glenarm Castle.....	4·92	125	...
,, .	Barra, Castlebay	2·59	66	...	,, .	Ballymena, Harryville	5·76	146	168
R&C	Alness, Ardross Cas. ..	4·32	110	143	*Lon .*	Londonderry, Creggan	6·15	156	168
,, .	Ullapool.....	2·93	74	...	*Tyr .*	Donaghmore	5·51	140	...
,, .	Torridon, Bendamph..	6·42	163	118	,, .	Omagh, Edenfel	3·68	93	108
,, .	L. Carron, Plockton...	4·27	109	...	*Don .*	Malin Head	3·24	82	114
,, .	Stornoway	4·84	123	160	,, .	Rathmullen.....	4·63	118	...
Suth.	Lairg	3·27	83	...	,, .	Dunfanaghy	3·19	81	92
,, .	Tongue Manse.....	3·72	95	122	,, .	Narin, Kiltoorish	4·42	112	...
,, .	Melvich School.....	3·29	84	118	,, .	Killybegs Rockmount.	5·41	137	123

Climatological Table for the British Empire, February, 1924

STATIONS	PRESSURE		TEMPERATURE							Relative Humidity	Mean Cloud Am'nt	PRECIPITATION			BRIGHT SUNSHINE	
			Absolute		Mean Values				Mean							
	Mean of Day M.S.L.	Diff. from Normal	Max.	Min.	Max.	Min.	½ max. and min.	Diff. from Normal	Wet Bulb.			Am'nt	Diff. from Normal	Days	Hours per day	Percentage of possible.
	mb.	mb.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	%	0—10	mm.	mm.			
London, Kew Obsy.	1017·8	+ 1·8	51	24	42·4	33·5	37·9	— 2·2	36·6	79	7·6	11	— 28	8	1·3	13
Gibraltar	1014·7	— 5·3	64	38	58·7	47·8	53·3	— 2·6	49·0	76	6·7	385	+278	18	...	...
Malta	1011·5	— 3·5	69	43	59·6	50·7	55·1	+ 0·8	50·6	79	5·5	50	— 1	12	5·7	52
Sierra Leone	1011·6	+ 0·6	93	70	87·9	72·1	80·0	— 2·3	72·7	68	2·6	14	+ 7	1	...	...
Lagos, Nigeria	1008·5	— 1·6	93	72	91·2	77·1	84·1	+ 2·0	79·7	73	6·7	28	— 23	2	...	...
Kaduna, Nigeria	1012·5	+ 0·5	98	...	94·1	...	...	...	66·3	43	0·7	0	— 5	0	...	...
Zomba, Nyasaland	1009·4	+ 1·6	87	59	77·7	63·8	70·7	— 1·0	...	89	8·3	283	+ 7	19	...	...
Salisbury, Rhodesia	1009·4	— 0·5	85	50	77·8	57·3	67·5	— 1·4	60·9	65	4·9	46	—136	7	...	...
Cape Town	1014·3	+ 0·9	100	56	81·7	61·5	71·6	+ 1·6	65·5	62	2·8	Trace	— 15	1	...	...
Johannesburg	1014·0	+ 1·5	82	41	72·9	52·4	62·7	— 2·7	54·8	69	3·2	74	— 56	13	8·1	62
Mauritius	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Bloemfontein	...	...	91	45	81·1	57·1	69·1	— 2·8	58·8	62	4·0	34	— 54	8	...	...
Calcutta, Alipore Obsy.	1012·1	— 1·2	91	56	85·0	62·0	73·5	+ 2·5	61·6	80	1·7	17	— 12	2*	...	...
Bombay	1011·5	— 1·1	88	62	83·2	69·4	76·3	+ 0·7	66·2	70	1·9	0	— 1	0*	...	...
Madras	1012·0	— 0·9	92	63	87·2	68·1	77·7	0·0	71·7	80	1·9	0	— 8	0*	...	...
Colombo, Ceylon	1010·2	— 0·4	93	68	89·1	72·9	81·0	+ 0·4	76·7	66	6·6	68	+ 15	5	8·5	71
Hong Kong	1015·4	— 3·4	75	49	63·6	57·3	60·5	+ 1·4	57·9	86	9·3	115	+ 72	12	1·5	14
Sandakan	...	...	88	72	85·7	74·9	80·3	+ 0·2	76·5	78	...	339	+ 95	9	...	...
Sydney	1011·6	— 2·4	92	57	81·0	65·4	73·2	+ 2·0	66·1	65	5·2	59	— 57	13	7·1	53
Melbourne	1011·5	— 3·0	93	40	74·6	55·7	65·1	— 2·3	60·0	62	6·4	96	+ 52	15	6·3	48
Adelaide	1012·5	— 1·8	98	50	80·8	58·5	69·7	— 4·4	59·5	51	5·2	67	+ 50	11	7·5	57
Perth, W. Australia	1013·5	+ 0·4	99	54	85·0	62·5	73·7	— 0·3	63·2	53	3·1	3	— 9	3	9·5	72
Coolgardie	1012·6	+ 0·1	105	47	88·9	60·4	74·7	— 1·3	61·9	37	2·8	49	+ 30	5	...	...
Brisbane	1012·3	+ 0·1	96	65	86·2	70·8	78·5	+ 2·0	72·9	71	6·4	235	+ 70	14	7·1	54
Hobart, Tasmania	1010·0	— 3·5	78	43	66·1	53·2	59·7	— 2·7	54·5	69	7·4	86	+ 49	16	5·5	40
Wellington, N.Z.	1016·4	+ 1·1	75	51	70·9	59·5	65·2	+ 2·8	59·9	72	6·1	108	+ 25	10	7·4	54
Suva, Fiji	1009·2	+ 1·5	89	69	85·8	73·1	79·5	— 1·0	76·6	82	6·0	286	+ 29	22	...	...
Kingston, Jamaica	1016·2	+ 0·9	91	62	86·5	68·1	77·3	+ 0·8	69·5	66	4·8	9	— 6	4	...	...
Grenada, W.I.	1015·4	+ 2·0	85	68	82·8	71·3	77·1	+ 0·1	71·9	74	4·1	76	+ 4	17	...	...
Toronto	1019·6	+ 1·6	39	— 2	27·6	12·9	20·3	— 1·4	17·1	53	6·4	83	+ 17	15	4·2	40
Winnipeg	1024·7	+ 2·9	46	—22	22·0	2·1	12·1	+12·7	...	...	4·6	10	— 10	6	4·6	46
St. John, N.B.	1014·2	+ 0·1	37	— 3	24·1	8·5	16·3	— 3·6	13·2	58	5·3	52	— 47	7	5·6	54
Victoria, B.C.	1019·8	+ 3·9	53	35	49·4	40·9	45·1	+ 4·8	42·6	88	7·8	134	+ 44	20	3·1	31

* For Indian stations a rain day is a day on which 0·1 in. (2·5 mm.) or more rain has fallen.

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British Association for the Advancement of Science

MEETING IN TORONTO, AUGUST 1924

THE annual meeting of the British Association for the Advancement of Science was held this year during the week August 6th to August 13th, in the very pleasantly situated buildings of the University of Toronto, and the gathering proved to be one of the most successful of recent years from the meteorological point of view. The meeting brought together a large number of distinguished meteorologists from Europe and America, including Sir Napier Shaw, Sir Frederic Stupart, Director of the Meteorological Service of Canada, Professor C. F. Marvin, Chief of the United States Weather Bureau, and Professor V. Bjerknes of Bergen, Norway, and formal and informal discussions were held, giving valuable opportunities for the exchange of ideas between investigators of the two continents.

Meteorological activities commenced during the voyage from Liverpool to Quebec, in the Cunarder " R.M.S. Caronia," of a party of meteorologists, who carried out work on a plan drawn up by a Committee appointed by the Council of the Royal Meteorological Society. The outstanding feature of this work was an enquiry into the vertical temperature gradients in the little explored region of the atmosphere lying below the masthead of the ship, use being made of an electrical resistance thermometer specially constructed by Mr. L. F. Richardson.

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Observations were obtained at numerous points along the route, including the Straits of Belle Isle, and a variety of conditions were found, including some cases of " inversions," in which the highest temperature in the strata considered occurred at the mast-head. Another problem attacked was the difficult one of obtaining a satisfactory exposure for thermometers on board ship to give true air temperature. In this connection, Mr. F. J. W. Whipple carried out a temperature survey of certain parts of the ship, using an Assmann psychrometer. This only emphasised the importance of the enquiry, showing that, even on overcast days, contact with the ship may affect the temperature of the arriving air with surprising rapidity. Air and sea temperatures reported by wireless from ships plays an important part in weather forecasting in England and other countries, so that the results of the present investigation should be of very practical value. Other work done was the construction of daily weather charts, and the preparation of forecasts from data received by wireless from ships and land stations. This was carried out by Mr. J. Bjerknes and Mr. M. A. Giblett in collaboration, and the charts not only added greatly to the interest of the voyage, but, being made with no preliminary preparation, demonstrated the extent to which the existing wireless weather organisation enables such work to be done in the northern part of the North Atlantic. It is gratifying to record that in mid-ocean it was possible to draw a weather chart extending from Russia across the Atlantic to the Pacific coast of America, though this was no longer possible during the later stages of the voyage.

During the subsequent meeting in Toronto, an afternoon was devoted to the discussion of the above work, and on the same occasion Dr. J. S. Owens described some interesting observations of atmospheric impurity made on the " Caronia." A white haze observed on the St. Lawrence in the neighbourhood of Anticosti Island, shortly before sunset, was found to consist of hygroscopic salt particles, although readings of an Assmann psychrometer showed the air to be relatively dry. (An apparently similar haze observed later on Lake Ontario consisted of solid particles, almost certainly soot.)

It would be impossible to deal in detail with the numerous papers read on meteorological and allied subjects, and only a very brief account will be attempted. Sir Napier Shaw, under the rather amusing title " If the Earth went Dry," invited the audience to consider what the condition of the atmosphere and the general circulation would be like if there were no water vapour at all in the air. Although the subject is hypothetical, the picture presented as the result of the technical discussion is likely to aid considerably in understanding the workings of the atmosphere as it actually is. Striking particulars as to the

great variations of mean temperature which may occur between one winter and another in Canada were given by Sir Frederic Stupart. It appears that in certain years the Pacific cyclonic systems are less intense than in others, and enter the continent farther south, while great anticyclonic developments occur in the far north and sweep south-eastward over Canada. These are conditions which lead to abnormally cold winters. On the other hand, mild winters are associated with vigorous cyclonic systems entering the continent in high latitudes. It is thought that a connection may exist between this difference of behaviour of depressions and the temperature and position of the Japan current, and the matter is being looked into.

Professor C. F. Marvin again brought forward the subject of a simplified calendar, urging meteorologists to promote the adoption of the simple equal month calendar others are now advocating. He supported the plea by showing the great practical advantages of having statistical data covering the fields of meteorology, yields and prices of crops, business and economic conditions, etc., appropriately assembled, summarised in suitable units of time and sectional area or representative groups, and promptly, regularly and systematically published.

Upper air work was represented by several papers. The average variation of wind with height above the surface shows certain definite characteristics which Professor W. J. Humphreys explained as effects of mechanical and thermal turbulence. The progressive development of upper air research in Canada, formed the subject of an address by Mr. J. Patterson, while a valuable series of upper wind measurements made at Samoa, was described by Mr. A. Thomson. These latter observations fill a gap in our knowledge of conditions over the Pacific Ocean, and show a very definite average maximum of wind velocity at a height of 12 km. If the region of maximum velocity corresponds to the tropopause, as in temperate latitudes, then the stratosphere is considerably lower than might be expected in the latitude of Samoa.

Mr. J. Bjerknes outlined further work emphasising the importance of atmospheric discontinuities in weather forecasting. The main point made was that the temperature distribution in a depression gives useful indication concerning its development. The result is capable of mathematical expression leading theoretically to a mathematical forecast, and an example of such a forecast in practice was given. Although the various methods of " rain making " which have from time to time been proposed are usually turned aside by the meteorologist, Professor W. J. Humphreys showed that each when treated quantitatively is full of meteorological interest. But, of course, none of these methods is practicable in the commercial sense.

The subject of radiation was represented by a paper by Pro-

fessor H. H. Kimball, who described work on the determination of daylight intensity from automatic records of total solar and sky radiation. Mr. F. J. W. Whipple showed an interesting laboratory reproduction of the "green flash," illustrating the theory that the phenomenon is due to simultaneous action of dispersion and absorption. In another paper he discussed the problem, as yet unsolved, of the diurnal variation of pressure. The facts as shown by observational material available from stations in the British Isles were shown to be hard to reconcile with Lord Kelvin's resonance hypothesis, to which other objections may also be raised. Mr. L. F. Richardson gave particulars of some further work on atmospheric turbulence, for which he is so well known. This time the field of investigation was among trees, where the gustiness as measured by a Dines pressure-tube anemometer was compared with the vertical temperature gradient measured by a pair of thermojunctions placed at different heights.

The automatic measurement of atmospheric pollution was described by Dr. J. S. Owens, and Dr. H. Jeffreys discoursed on "Tidal Friction." The Rev. A. L. Cortie gave further information as to his researches into the nature of the relation between solar activity and terrestrial magnetic disturbance.

Seismology was represented by contributions by Mr. E. A. Hodgson, of Ottawa, on the correlation of records of two distant Milne-Shaw Seismographs, and by Mr. J. J. Shaw, who presented the report of the Seismology Committee. The latter contained the result of experiments testifying to the very satisfactory nature of the Milne-Shaw Seismograph, also a note to the effect that research has shown that the 21-minute periodicity, already mentioned in previous reports, is probably controlled by the moon, being of the nature of a tidal effect.

In addition to the above papers read in section A (Mathematics and Physics), Dr. Vaughan Cornish discussed wind, wave and swell on the North Atlantic Ocean, before the geographical section. One important conclusion was that the growth of waves is much hindered by a crossing swell, so that it can be inferred that the general absence of swell upon enclosed seas favours the rapid rise of waves. Dr. W. Bell Dawson shewed the great progress made in the period 1893 to 1924 in the survey of tides and currents in Canadian waters, and in the agricultural section Mr. R. A. Fisher discussed the incidence of rainfall in relation to the wheat crop. In the geological section Pre-Cambrian climates were described by Professor A. P. Coleman, who concluded that "On the whole, the Pre-Cambrian formations indicate cooler conditions than the Palæozoic up to the end of the Carboniferous, and much cooler conditions than those of the Mesozoic." Even in the programme of the Zoological section

there was a paper on the circulation of the water off the Canadian Atlantic Coast, in which Professor A. G. Huntsman drew deductions from the distribution of planktonic forms, including the larvæ of fishes. The circulation indicated was confirmed by observation with drift bottles.

Meteorological activities were not confined to the British Association meetings, a number of papers being contributed to the geophysical section of the International Mathematical Congress, which also met in Toronto during the same period. These included contributions by Sir Napier Shaw, Professor V. Bjerknes, Professor W. J. Humphreys, and Mr. J. Patterson, while other branches of geophysics were also represented.

A scientific exhibition was held throughout the meetings, and to this some instrumental exhibits were contributed by the Meteorological Service of Canada, which also undertook the daily display of weather charts and forecasts in a prominent position.

The custom of holding a Meteorological Luncheon in the course of the meeting was duly honoured, a party of 59, meteorologists and their friends, assembling at Hart House. Sir Napier Shaw presided. After the loyal toast, Sir Napier welcomed the representatives of various sciences, emphasising the universal importance of weather and the numerous points of contact of meteorology and other subjects. Professor E. W. Brown of Yale, representing Astronomy, spoke of the opportunity which would be afforded by the eclipse of January next year for showing the general public the possibilities of weather forecasting. It was hoped that the public would be co-operating with the astronomers by reporting observations from which the boundary of the band of totality could be determined with high precision, and all would be anxiously hoping for clear skies on the critical day.

An interesting speech was delivered by Dr. L. A. Bauer, representing terrestrial magnetism and electricity, while Professor V. Bjerknes, as a representative of physical sciences, remarked that if ten years ago he had been asked which was the more probable—the splitting of atoms or the solution of the problem of weather forecasting, he would have answered without hesitation, forecasting. He drew the moral that we should tackle weather problems with enthusiasm and the assurance that our efforts would be crowned with success. Sir Henry Rew, speaking as an agriculturalist, thought that meteorologists did not always receive the credit due to them for success in forecasting. He told the story of the Englishman, who was asked by an Australian who had been suffering from a chilly May in London, when the summer would come, and replied " Last year we had it on a Wednesday."

Mr. J. J. Shaw, who spoke for seismology, traced many connections between his science and meteorology. He pointed out that the origin of microseisms had not yet been ascertained, and that the idea that they came from the swell in the oceans would probably have to be abandoned. The oscillations of the ground owing to the alternate heating and cooling of a house on days with passing clouds, were quite appreciable by the seismograph. Professor C. F. Marvin, spoke with enthusiasm of the benefit of personal contact between scientists, and especially between meteorologists, at such international gatherings.

The chairman, in a toast to " Toronto Hospitality," expressed the gratitude of all who had taken part in the meeting to Sir Frederic Stupart for his efforts to make it a success, and, in reply, Sir Frederic spoke of the welcome which Canadians wished to give to their colleagues from England and the United States, and gave credit to Mr. J. Patterson for his part in the preparations for the meeting.

M: A. G.

The Wet Weather of April to August, 1924

By C. E. P. Brooks, M.Sc.

Following the dry, cold weather of the winter and early spring, the British Isles have experienced a period of five months with excess of rainfall, especially in England and Wales. Summarising the figures published in the *Meteorological Magazine* each month, we have the following percentages of the average fall (1881—1915) :—

	April	May	June	July	Aug.	MEAN
England and Wales ...	145	214	104	152	114	146
Scotland	95	161	108	152	113	126
Ireland	125	159	129	132	112	131
British Isles	128	189	110	149	113	138
South-east England ...	183	217	118	166	121	161

The rainfall was rather unevenly distributed. In April, Scotland and the north of England were generally dry, while the counties near London had twice their normal amount. In May the excess was more uniform, but the north-west of the Scottish mainland had a rainfall below normal, while parts of Kent and Gloucester had over three times their normal total. In June the excess was greatest in the south and south-west of the British Isles, and the east coast of England was relatively dry, while in July the greatest percentage excess was in London and the Midlands. In August the excess was greatest in Sussex

and the counties to the west and south of London and also in the north of Scotland and Ireland. Thus south-eastern England suffered throughout; this is brought out by the figures in the last line of the table, which refer to twenty stations within the triangle including Norfolk, Hampshire and Kent. Generally speaking, the five months in question formed a decidedly rainy period, without being in any way phenomenal. The rains of April to June and August were chiefly cyclonic, those of July, in England at least, were largely associated with thunderstorms.

The first step in elucidating the causes of this rainy period is to discuss the abnormalities of pressure with which it was associated. The chart of pressure deviations for March was highly abnormal, pressure being more than 15 mb. below normal over the Azores.* It has been found that centres of negative pressure deviation often move across the chart in a similar way to the barometric depressions shown on daily weather maps, but more slowly. Thus, in March 1912, a marked centre of negative anomaly lay over the British Isles, while in April a similar centre lay to the north of Norway. By constructing a series of 32 charts covering the periods March 1st to 30th, March 2nd to 31st, March 3rd to April 1st and so on, the track of this centre was traced, and it was found that it moved in an almost straight line north-eastward from the British Isles, at a rate just sufficient to carry it to the north of Norway in a month. This progressive movement of low pressure centres was well shown during the late spring and summer of 1924, see Fig. 1, in which the Roman numerals refer to the months of the year. The centre A which lay over the Azores in March 1924, moved north-eastward, and in April lay over Scandinavia. Meanwhile a new negative centre B had appeared north-west of the Azores. In May, centre A had moved into the Arctic Ocean somewhere east of Vardo, while the new centre B had moved to the neighbourhood of the west coast of Ireland. In June, centre B had in turn moved to Scandinavia, and a third centre C had appeared in the North Atlantic, somewhere east of Newfoundland and south of Greenland. In July, centre B lay over the Arctic Ocean, and C occupied a position between Ireland and Iceland. In August centre C had moved only slightly north-eastward, being near the Faroës, and an area of positive anomaly had appeared over the Atlantic to the north of the Azores. In March, pressure was well above normal over Iceland, Jan Mayen and Spitzbergen, and this high pressure persisted throughout April, May and June (Fig. 2). At the same time, pressure was generally above normal over a belt extending in a west-south-westerly

* The chart for March is shown on p. 80 of the *Meteorological Magazine* for May 1924.

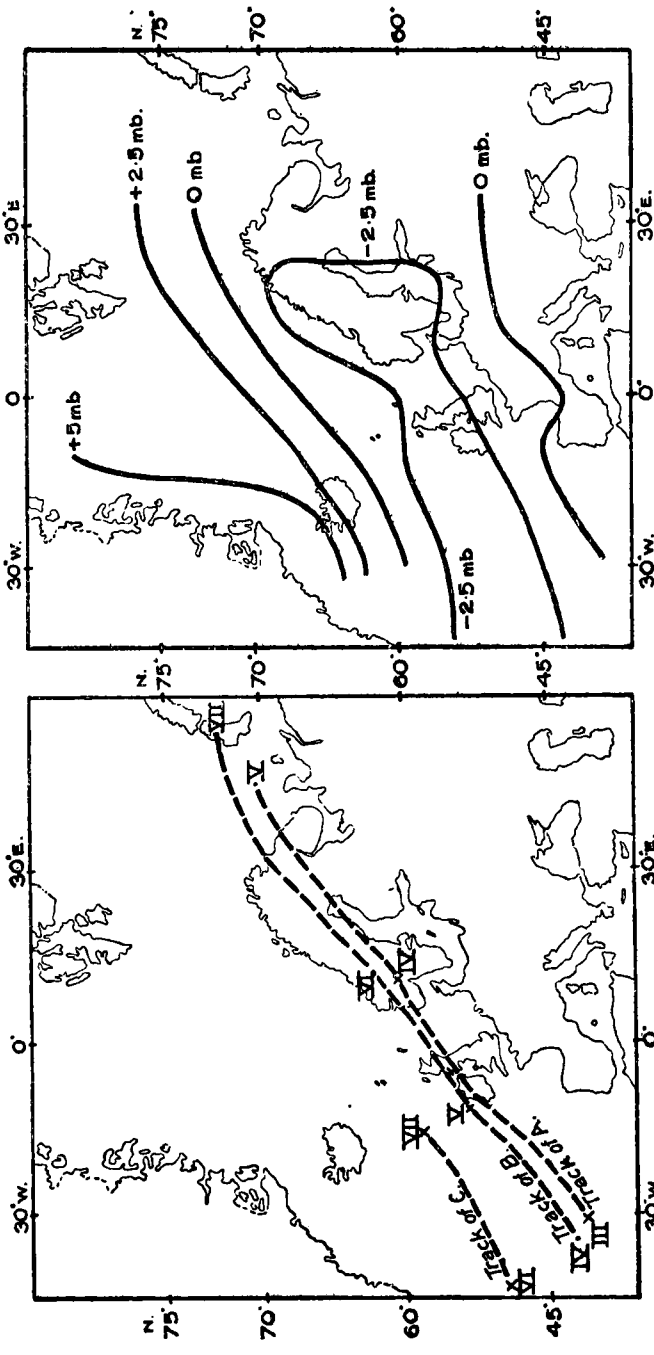

Fig. 1. Tracks of Centres of Negative Pressure Deviation.

Fig. 2. Deviations of Pressure, April to June.

direction from southern Russia, across Italy and Spain towards Madeira. The average pressure distribution during these three months is shown in Fig. 2, from which it will be seen that centres A and B were travelling along a corridor between two centres of high pressure. In July the high pressure between Iceland and Spitzbergen broke down, giving place to small negative deviations, and, with the barometer remaining high over Spain, centre C followed a more northerly course. In August the conditions had changed still more. Pressure was high in the rear of centre C and over Spain, and, the negative deviations over the Baltic having become very slight, the course of centre C was turning more northwards.

The abnormal pressure distribution of the winter and early spring was tentatively attributed to an exceptionally high temperature over the Arctic Ocean,* which persisted from September to February. In the Arctic, high temperature is associated with low pressure and great storminess, which breaks up the edges of the palæocrystic ice and sets free large quantities of field ice to pass into the East Greenland Current.† Ice conditions off East Greenland this year were severe enough to interfere for a time with the plans of the United States flight from Iceland to Greenland, and an unusual amount of ice is certainly effective in raising the mean pressure of spring and early summer. W. Weise‡ found also a southward shift of the mean tracks of depressions during years with much ice in the Greenland Sea compared with the tracks during years with little ice, the average difference being about three degrees of latitude. The East Greenland ice conditions were probably one of the causes of the rainy spell.

Fluctuations in the strength and temperature of the Gulf Stream sometimes have an appreciable effect on the subsequent pressure conditions over the North Atlantic, but on this occasion the Gulf Stream must be held guiltless. The pressure gradient from the Azores to the African coast and from Bermuda to Charleston at the appropriate times approximated to normal, and Commander E. H. Smith, of the Atlantic Ice Patrol, informs me that the temperature of the Gulf Stream off Newfoundland in spring was also normal.

Over the Grand Banks of Newfoundland, between the Gulf Stream and the Labrador Current, the water forms a slowly rotating whirl which is largely isolated from the surrounding

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* *Meteorological Magazine*, Vol. 59, May 1924, p. 79.

† *Q.J.R. Met. Soc.*, Vol. xlviii, 1922, p. 162.

‡ Die Einwirkung des Polareises im Grönlandischen Meere auf die Nordatlantische Zyklonale Tätigkeit. *Ann. Hydrogr., Berlin*, Vol. 50, 1922, p. 271.

currents, and which is kept at an almost uniform temperature through its whole depth of 35 to 40 fathoms owing to mixing. This water is usually very close to 32° F., but in the spring of 1924 it was 5 to 7° F. warmer. Commander Smith attributes this high temperature to the mild winter and the absence of field ice. Pressure data for the south of Greenland are not yet available, but during the three months, January to March, pressure at St. John's, Newfoundland, was 6·8 mb. below normal, whilst pressure at Reykjavik, Iceland, was 1·4 mb. above normal. In these three months St. John's is normally 7·8 mb. above Reykjavik, but in 1924 it was 0·4 mb. below. Hence the strong winds which normally drive the ice and cold surface waters from Davis Strait into the Atlantic were absent, and light winds from the opposite direction predominated. This explains the absence of field ice.

I had previously found a positive correlation between the pressure difference Sydney (Nova Scotia)-Ivigtut (south Greenland) in January to March (1891-1915), and the pressure over Western Europe in the following April to June. This is presumably due to the action of the cold Labrador current in lowering the temperature of and raising the pressure over the eastward-drifting waters of the North Atlantic north of 50° N. According to the results for 1891 to 1915, a pressure-difference between Sydney and Ivigtut, 8 mb. below normal in January to March, should give a pressure deficit during April to June of 4 mb. at Bergen and about 2·4 mb. at Paris and Berlin. These are near enough to the deficits actually found in April to June 1924, to give reason for supposing that the trough of low pressure across western and northern Europe shown in Fig. 2 is a direct consequence of the holding back of the Labrador Current in January to March.

The effect of the Sydney-Ivigtut pressure difference appears to persist until about the fifth month. As the reversal of the normal gradient was greatest in March, there was a tendency for the low pressure trough to continue during August. On the other hand, the effect of ice in the Greenland Sea on pressure is much greater during April, May and June than later in the year, Hence the belt of maximum negative pressure deviation tended to shift northward during July, and southern England was visited by secondaries instead of by the main depressions, giving the month its thundery character. During August, however, the centre of negative deviation lay so close to the north of the British Isles that these islands lay under cyclonic conditions during the greater part of the month.

Meteorological observers are reminded that Summer Time will cease on September 21st at 2h. G.M.T.

OFFICIAL NOTICES

Lightning Investigation

THE Director of the Meteorological Office is investigating the form of lightning discharges, and is very desirous of inspecting as many photographs of lightning as possible. He would therefore be very grateful for the opportunity of inspecting any photographs of lightning which our readers may possess. It is not necessary that the photographs should be technically good, any photograph showing the form of the flash will be valuable.

Photographs will be returned if required as soon as they have been examined.

Discussions at the Meteorological Office

THE series of meetings for the discussion of recent contributions to meteorological literature, especially in foreign and colonial journals, will be resumed at the Meteorological Office during the session 1924-25. The meetings will be held on alternate Mondays at 5 p.m., beginning on Monday, October 13th, 1924, when Dr. Simpson, F.R.S., will open the discussion.

The dates for subsequent meetings are as follows :—

> October 27th; November 10th and 24th, 1924; January 19th; February 2nd and 16th; March 2nd and 16th, 1925.

The Director of the Meteorological Office wishes it to be known that visitors are welcomed at these meetings.

Correspondence

To the Editor, *The Meteorological Magazine*

Fate of Old Weather Records

I WILL not assert that the notes on the vagaries of our climate which we know to have been made by our forefathers of two or three centuries ago were worth their weight in gold, but if they had been handed down to us intact they would, in their simple form, be found of considerable value for modern investigation purposes. Only the merest handful of old registers have been unearthed in the course of recent years, and yet it is certain that many persons did take observations and wrote them for preservation, thinking no doubt that they would be of interest to posterity. What has become of them? As regards some important ones the following provides the answer, which will

be a surprise to many, perhaps to most, readers of the *Meteorological Magazine.*

In the course of the present year *Nature* has given a series of extracts from the Early Science records of the Royal Society, and in the issue for June 28th, 1924, p. 946, there appeared this paragraph :—

> " June 25th, 1684. There was shown an account of the weather during the month of May last, as it was observed at Dublin by Mr. Willian Molyneux."

Many years ago when collecting information for an article on " The Great Storm of 1703," which appeared in the *Cornhill Magazine* for November 1897, I visited Burlington House in the hope of finding some helpful observations in the archives of the Royal Society, but I was disappointed—the Society had nothing.

My next essay was to search numbers of the Philosophical Transactions, but while the result was very disappointing, it afforded a clue to what had become of such records as had been committed to the custody of the Royal Society. In the volume for 1705, at p. 200, there is a reference to Towneley's and Derham's meteorological observations for 1703 and the first part of 1704, ending with " The registers of the winds and weather are omitted as useless." (They included barometer observations by both, certainly for November 25th-29th, and very good ones too, for they were copied by DeFoe for his work on " The Storm.") At p. 206 of the same volume appears a note on the weather register kept by Mr. John Locke, at Oakes, Essex, for the year 1692, giving the state of the barometer, thermometer, hygrometer, wind and weather, " the particulars of which are now no longer of any use." In the volume for 1707, p. 347, Derham's meteorological tables for 1705 are referred to—" This register of the weather it is of no use now to retain."

The Assistant Secretaries afterwards informed me that the Society used to destroy all such documents after storing them for a time, apparently a couple of years. It looks as if we have thus been deprived of series of records for at least the years 1684 to 1705, a period of 22 years, by the best observers of those days.

HY. HARRIES.

10, *Tennis Road, Hove, Brighton. August 8th,* 1924.

Cloud Observations

YOUR readers may be interested in a use to which we have been putting a pilot balloon theodolite at the Central Weather Bureau recently. When used to follow a cloud point in the same way as a balloon it forms a very convenient nephoscope. The cloud direction and relative velocity can readily be derived by

a similar computation to that for a balloon. If an estimate of the cloud height be made, a close approximation to the wind velocity at that height can be deduced.

The method is an obvious one, but it had not occurred to the writer, and the same is probably true of others, to use it until lately. It is more rapid than nephoscope observations of the usual type and generally more accurate. Its value for military purposes in cloudy weather is obvious.

EDWARD KIDSON.

Meteorological Bureau, Melbourne. June 5th, 1924.

A Fireball in 1792

IN the *Chichester Diocesan Gazette* for August, 1924, in an article entitled "Master John Bourne, A Glimpse of Church Life in East Sussex in the Days of George III." by the Rev. G. E. Frewer, there is the following extract from the Journal of the above John Bourne, of Brede, who died in 1793.

> "1792. Nov. 25. Mr. Davis taught a Sermon concerning misforten by a Ball of fire or Litening a few days before on a house in Brede neare the King's head. The dwellers where Mast. Bates Henry Stonham Thos. Fox a single man and Furminger a neighbour unluckily being theire going out part of the Chimly fell on him which hurt him very much. The Tax 2 Sam xxii 14-15. 'The Lord thundered from Heaven . . . He sent out lightning and discomfited them.'"

Mr. Frewer adds "I wish I knew if Mr. Davis' treatment of this passage were moral, spiritual or mystical."

CICELY M. BOTLEY.

10, *Wellington Road, Hastings. August 31st,* 1924.

Heavy Rainfall in Ireland

THE rainfall here at Coolatore for the past 24 hrs. taken this morning was 1·44 in., the fourth heaviest fall in the 24 hrs. for the last 20 years.

H. A. S. UPTON.

Coolatore, Moate, Westmeath. September 8th, 1924.

According to the *Times* a new "record" for a gliding flight has been made at the aerodrome of Les Alpilles near St. Rémy-en-Provence by Lieut. Thoret the French pilot. He remained in the air with the engine of his machine stopped for 9h. 8m. The previous record was held by a German airman who was in the air for 8h. 42m.

NOTES AND QUERIES

Dr. A. Crichton Mitchell

By the retirement on September 30th of Dr. A. Crichton Mitchell the Meteorological Office loses not only an efficient Superintendent but also a real friend in need. When in 1916 every young and able-bodied man wished to do "his bit," Mr. L. F. Richardson, who was then in charge of the Observatory at Eskdalemuir, was pressing the Director to let him get away to France with an ambulance corps, Dr. Mitchell's offer to undertake any job for the Meteorological Office came as a godsend.

Dr. Mitchell had spent many years in India in the Travancore Education Service, and retired in 1913 as Director of Public Instruction. On his return to Scotland he commenced working in physics at the Edinburgh University, but on the outbreak of war he threw himself with characteristic energy into experimenting on harbour defences. Feeling, however, that he would like to undertake some regular work which would set a younger man free for war service, he offered his services to Sir Napier Shaw. Sir Napier received this proposal with delight, and, when he offered Dr. Mitchell the post of Superintendent of the Eskdalemuir Observatory, the latter was nearly equally pleased, for it was work he loved and work with which he was quite familiar, having been in charge of a similar observatory for nearly twenty years at Trivandrum. Dr. Mitchell took up his duties as Superintendent at Eskdalemuir on May 15th, 1916.

The Meteorological Office was again in difficulties in 1920. The Office had taken over from the Scottish Meteorological Society the administration of the Meteorological Office, Edinburgh, and had also undertaken the establishment of a geophysical observatory in the Shetlands. A man was wanted to organise all this work, and, in his need, Sir Napier Shaw again turned to Dr. Mitchell. In the end, Dr. Mitchell was given a sort of roving commission for two years "to superintend what needs to be superintended at Edinburgh, Eskdalemuir and the Shetlands." This was really a very tall order, but work and responsibility never daunted Dr. Mitchell. He retained his headquarters at Eskdalemuir but spent a great deal of time in Edinburgh and made several visits to the Shetlands. He rapidly put the Edinburgh Meteorological Office on its feet, and organised the Geophysical Observatory in Lerwick, the latter being almost entirely the product of Dr. Mitchell's enthusiasm and energy. At the end of two years some of the strain was taken off Dr. Mitchell's shoulders by the appointment of Captain Absalom to take charge of the observatory at Eskdalemuir

under the general supervision of Dr. Mitchell, who then removed to Edinburgh.

Dr. Mitchell can look back over the eight and a half years which he has spent in the Meteorological Office with satisfaction. He has left his mark not only on the official establishments but also on the general level of the meteorological work done voluntarily in Scotland. The great characteristic of Dr. Mitchell's work has been that he has known what he wanted, has worked to get it, and worked still harder when he had got it, but through it all he has shown perfect loyalty to Headquarters and has always been ready to carry out, under instructions, second-best plans when his own ideals could not be attained. G.C.S.

Heavy Rainfall of the Early Morning of August 19th at Cannington, in Somerset

THE heavy rainfall to the east of the Quantock Hills was remarkable for giving one of the largest falls ever recorded in one rainfall day in the British Isles. At Brymore House, about three-quarters of a mile to the west of Cannington, near Bridgwater, the measurement at 9 a.m. on August 19th (*i.e.*, for the rainfall day of the 18th), was 9·04 in.

The largest falls recorded previously are :—

Somerset	...Bruton, Sexey's School ...	...9.56 in.	on June 28th, 1917
,,	... ,, King's School ...	...8.48 in.	,, ,,
,,	...Aisholt, Timbercombe ...	...8.39 in.	,, ,,
Inverness	...Loch Quoich, Kinlochquoich	...8.20 in.	,, Oct. 11th, 1916
Cumberland	...Borrowdale, Seathwaite ...	...8.03 in.	,, Nov. 12th, 1897

Thus only one larger fall has been reported in the British Isles.

Mr. W. Kendall, who measured the rainfall in the presence of two gardeners, has supplied the following details of this large measurement : " About 8½ in. of this rain and hail fell between 3 a.m. and 7.30 a.m. on the 19th. There had been no rain before 11 p.m. on the 18th but several heavy showers fell by 3 a.m. Thunder was heard in the west. It then commenced to rain very heavily and thunder got quite close and frequent. The rain and hail almost stifled the noise of the thunder. As soon as one could see out the place was like a river and in places the water was 4½ feet deep . . . . The raingauge I have here is a " Snowdon " and will hold about 10 in. of water."

Although no direct measurement was made in support of the 8½ in. in 4½ hours mentioned by Mr. Kendall, other observers agree that the period of most intense rainfall was between 3 and 7.30 a.m. There seems little doubt therefore that over that period the mean rate of fall at Brymore House must have been well over 1 in. an hour. Further details are requested about the heavy rainfall in this area.

Reports of damage done by floods suggest that there were two distinct areas of heavy rainfall. One area on the eastern side of the Quantock Hills included the villages of Stogursey, Combwich, Cannington, Fiddington and Nether Stowey. On the other side of Bridgwater heavy rain fell on the Polden Hills, especially in the villages of Cossington, Catcott and Ashcott. No measurements of rainfall are available in either of these areas other than that at Brymore House. From just outside the Quantock Hills area of exceptional damage two rainfall readings have, however, been received, viz., 4·50 in. at Ashford (1 mile to the south-west of Brymore House) and 3·93 in. at Fairfield House to the west of Stogursey. These falls, taken in conjunction with reports of damages, floods, etc., appear to confirm the exceptional amount recorded at Brymore House.

The heavy rainfall was confined to a small area, more than 4 in. probably falling on about 10 sq. miles. In the case of the Bruton rain of June 28th, 1917, more than 4 in. fell over 809 sq. miles. At a distance of 6 miles to the south-west and 7 miles to the north-east of Brymore House only half an inch was recorded. In fact outside an area stretching from Watchet to Warminster more than half an inch of rain appears to have occurred on the rainfall day, August 18th, only in the districts of Dartmoor, Exmoor, and Central Wales.

Many observers commented on the hail which accompanied the rain. Lord St. Audries mentions that at Fairfield House flooding occurred " by water getting into the house owing to the gutters being blocked by hailstones. The following evening there were still remaining immense heaps of hail stones in the back yard which had been removed from the gutters." At Edington on the edge of the Polden Hills there was " a tremendous fall of hail, some of which remained till next evening."

Another feature of special interest is that this is the second measurement of unusually heavy rain in the district. Timbercombe, where the large fall already mentioned of 8·39 in. was measured in 1917, is only 5 miles to the south-west of Brymore House. The fall of the 28th June, 1917, at Brymore House was 4·91 in.

It appears to have rained in the Quantock Hills and Polden Hills on every day from the 14th to 30th. Lord St. Audries writing from St. Audries on August 31st makes these interesting comments: " The recent heavy downpours have been accompanied by remarkably little wind, and in some cases have moved extraordinarily slowly. Several times I have seen and heard of rain a couple of hundred yards off several minutes before it has reached this house." The rainfall of the 19th and 22nd was considerable, as much as ·50 in. and 1·00 in. respectively falling over a large area to the east of the Quantock Hills. The total

for the month at Brymore House was 13·11 in.

Utilising the record at Brymore House, which extends back to 1904, a value of 2·8 in. has been calculated as the average August rainfall for the period 1881 to 1915. The fall of 13·11 in. is 470 per cent. of the average. This is comparable with the maximum monthly percentage falls in the areas of the Bruton and Norwich rains of June, 1917, and August, 1912, respectively. The values were: June, 1917, 410 per cent.; August, 1912, 470 per cent. of the average 1881 to 1915.

J.G.

The Chinese Floods

WHILE England is bewailing a lost summer, China is suffering from floods which are unparalleled in the present century. In the province of Chih-li 25,000 square miles of rich agricultural plain are under water, and it is estimated that nearly five million people are homeless. The level of the water is three feet higher than during the great flood of 1917, when three million people were involved and the material damage done was estimated at £25,000,000.

The district between Tientsin and the Shansi Mountains is the meeting ground of five rivers, all of which bring down great quantities of silt from the mountains. This is deposited in the river bed, raising its level. The waters are restrained by embankments, and in places flow many feet above the level of the surrounding country, so that if a gap is broken in the embankment a river may flood a wide area of country. The average annual rainfall is not large—only twenty inches a year, but it falls almost entirely within the three months July to September, and since the deforestation of the mountains the summer months have been a period of anxiety even in normal years. This year, the summer rainfall has been abnormally heavy; at Pekin 26 in. fell during July alone, 9·38 in. falling in two days (15th and 16th), while at Tientsin 32 in. fell in three weeks. Owing to these heavy rainstorms the rush of water from the mountains has broken numerous gaps in the banks, and the rivers have spread out over all the low-lying country. The floods are aggravated by the embankments which have been built from time to time to protect Tientsin, and which prevent the water from escaping directly to the sea. Up to the time of writing, Tientsin itself has not suffered greatly, but there is still a month of the rainy season to pass, and if the abnormal rainfall continues the water may break through the embankments and flood the whole city.

The meteorological situation which favours floods in north China is a strengthening of the south-east monsoon. This comes about owing to a fall of pressure below normal over the

of measuring tapes constructed of invar. Ramsden's theodolite interior, while the North Pacific anticyclone occupies a more northerly position than usual. The stronger monsoon not only brings more rain but to some extent holds back the water in the rivers. This condition of affairs occurred in 1911 and 1917, and so far as one can judge from the scattered information available, a similar situation began to develop in May of this year. The main flood problem of north China, however, is one not of meteorology but of river conservancy.

If two new outlets to the sea were cut, one to the north and one to the south of Tientsin, the danger of excessive floods would be averted. An admirable article in *The Times* of September 2nd points out that after the flood of 1917 the Chih-li Conservancy Commission prepared definite plans to this effect which would require an expenditure less than the average annual loss, but in the present condition of the country there is no likelihood that these will be carried out.

The Geophysical Exhibition at the Science Museum

THIS exhibition has been arranged to supplement the exhibition of Geophysical work and instruments which has been organised by the Royal Society Committee of the British Empire Exhibition at Wembley. As the space in the British Government Pavilion is limited, many geophysical exhibits can only be shown there for a portion of the time during which the Exhibition at Wembley is open. They are therefore being exhibited in turn, each section being shown for a period of six weeks. In order, however, that the whole collection may be available to the public throughout the period of the Exhibition, accommodation has been provided at the Science Museum, in which the exhibits will remain on view for the rest of the period.

The sections included under the heading Geophysics, comprise Geodesy, Seismology, Terrestrial Magnetism, Atmospheric Electricity, Meteorology, Atmospheric Pollution, Hydrology and Gravity, each section being supplemented by a number of objects of interest selected from the collection of the Science Museum.

Geodesy is represented by three maps which illustrate respectively the first order triangulation, the precise levelling, and the topographical and geographical mapping of the Empire. Of the Museum exhibits, Colby's Bars and Ramsden's three foot altazimuth theodolite are specially interesting. Colby's Compensation Bars were designed to eliminate the errors due to the impossibility of determining accurately the temperature of ordinary measuring bars at the time of observation. They were used in determining some of the baselines for the Trigonometrical Survey of Great Britain, but they have now been superseded by the use

was constructed in 1790, and was in constant use in the Survey from 1792 to 1862.

The Seismology exhibit which was on view in the British Government Pavilion from August 18th to September 14th, includes Mr. J. J. Shaw's latest improvement of the Milne-Shaw seismograph, which is shown in operation, while on a map of the world are plotted the positions of seismological disturbances recorded during the period 1913-1919 at either Shide or Oxford. In addition a map is exhibited showing the seismological stations which send records to Oxford or have done so in the past.

In the Atmospheric Electricity section a number of records obtained at British Observatories indicate the variations of electric potential gradients associated with various types of weather, from the continous positive trace of fine weather to the violent fluctuations associated with thunderstorms. There is also a recording Dolezalek electrometer, used for recording the earth's potential gradient. Modern instruments in general use for measurement of the elements of Terrestrial Magnetism are displayed alongside instruments which were in use well over a hundred years ago. The most modern types of instruments, including the Schuster-Smith absolute magnetometer for determining the horizontal component, the Kew magnetometer for declination and horizontal force, and the Smith recording magnetograph, are remarkable for their delicacy and accuracy, and, one might almost add, for their beauty. This exhibit also includes records of magnetic storms taken simultaneously at the various geophysical observatories, and auroral sketches made by Dr. E. A. Wilson on Captain Scott's First (Discovery) Antarctic Expedition.

The Meteorology exhibit is very complete, and much greater space than is available here would be required to do justice to it. A case of ancient and modern weather charts includes a reproduction of part of the earliest journal of the weather in England, that kept by the Rev. William Merle from 1337-1344. Large maps show the distribution of the average annual rainfall over the whole world and the average loss by evaporation. Series of cloud photographs, including some taken from aeroplanes are arranged to show the various types of cloud formations, and these include an attractive series of transparencies by Mr. G. A. Clarke which can be lit up from behind. A photograph of the whole sky on one plate, taken by Mr. R. Hill with a special lens, is shown. The exhibition of instruments is admirably designed to show the history of the different types. The barometers include a "diagonal barometer," dating from about 1750, in which the upper portion of the tube is greatly inclined to obtain an open scale—a process rendered unnecessary by the invention of the vernier. Three cases are devoted to instruments for measuring

the humidity of the air, including Hooke's oat-beard hygrometer of 1664, Daniell's hygrometer (1819), and a number of instruments constructed of such varied material as hair, wood and whalebone. The anemometers include the first pressure-tube instrument, designed by Lind in 1775, and the curious shot pressure-plate anemometer for recording the maximum gust. Other cases contain sunshine recorders and radiation thermometers, and various types of rain-gauges, including Symons' Storm Gauge, referred to in the article on p. 150 of the August number of this magazine. Various forms of balloon and kite meteorographs are shown, together with the other equipment necessary for the investigation of the upper air.

The section on Atmospheric Pollution is represented by a set of the instruments employed in measuring this important element. The Gravity exhibit traces the history of the measurements of the density of the earth and the local variations of g, including the measurements at Schiehallien in 1774-6, the apparatus used by Baily in 1841-2, and that of C. V. Boys in 1889-94, both of which employ the attraction of large lead spheres. The most modern instruments include the Wade Latitude instrument and the Eötvös Torsion Balance. Two charts show the positions of gravity stations in Europe and the World, and there are a number of diagrams and records illustrating the methods employed and the results obtained by Dr. Vening Meinesz in his determination of gravity at sea in the Dutch Submarine KII during the latter part of 1923. The exhibition is an education in the history of the geophysical sciences, and especially in the great strides which have been made in the precision of measurements during recent years. Many of the instruments are dissected to show the principles on which they are based.

The Kew Pattern Barometer—Marine Type

THE outstanding difference in the design of the Kew pattern Marine Barometer and that of the Kew Station Barometer, is the introduction of a length of capillary in the tube of the former in order to reduce the " pumping " or oscillation of the mercury column due to the motion of the ship. The choice of the dimensions of the capillary portion is a matter of some importance, for they must be such that the capillary reduces appreciable pumping while not unduly interfering with the responsiveness of the barometer to pressure changes. These conditions are ensured in practice by specifying the " falling time " of the barometer, which is defined as the time taken by the mercury to fall from 1·5 to 0·5 in. above the true barometric height. In the case of marine barometers supplied by the Meteorological Office to observing ships, the falling time lies between 3 and 6 minutes.

The method of adjusting the capillary in order to ensure that the falling time comes within the specified limits varies among different instrument makers, but there is little doubt that, at the present time, the introduction of a suitable capillary involves a certain amount of manipulation. There has been no general method by which a maker could produce a marine barometer with a falling time within closer limits than those normally specified.

As a result of investigations carried out in the Instruments Division of the Meteorological Office during the last two years, it has now been possible to construct a Kew pattern Marine barometer having a given falling time. The method consists in simply specifying the bore of the glass tube at the top and the length and bore of the capillary in the middle of the tube. A special feature of the barometer is its wide cistern, in consequence of which the scale is only 1½ per cent. contracted as compared with the Fortin instrument. The various dimensions of the tube were so chosen that the falling time from 52 to 18 mb. above the actual barometric height would be five minutes. A barometer (No. M.O.2209) was made for the Office by Messrs. S. & A. Calderara of Springfield Gardens, Clapton, according to the new specification, and was found to have, actually, a falling time of five minutes, the difference between the theoretical and experimental values not exceeding two or three seconds. Also the " lagging time " of this barometer (M.O. 2209) was found to be in accordance with Stokes' theory. It is hoped that a paper on the subject will be published shortly.

A New Rain Measure

ONE of the difficulties which have been felt in the past by rainfall observers has been the accurate measurement of small quantities of rain of the order of an hundredth of an inch or less. In the ordinary pattern measuring glass with flat base it is very difficult to determine the lowest graduations with accuracy, and the errors in estimating falls of less than one-hundredth of an inch (one-tenth of a millimetre in the case of millimetre glasses) may well make a serious difference to the number of raindays reported at a particular station.

More than one attempt has been made in the past to improve the pattern of the measuring glass with a view to overcoming this defect. Among the modified forms, probably the best known is the " Camden " measure, which is used by several rainfall observers in this country. In this measure the glass tapers towards the bottom so that the graduations are more widely spaced than in the ordinary measure. Moreover a special graduation, ·005 in., is engraved on the glass so that the question whether the rainfall shall be counted as ·01 in. or " trace," may

be answered with confidence. The external diameter of the Camden is, however, uniform throughout its length, so that the lower tapered portion is surrounded by a thick wall of glass, and in taking readings at the lower graduations it is extremely difficult to avoid errors due to parallax. The advantages which the measure is intended to possess are largely discounted.

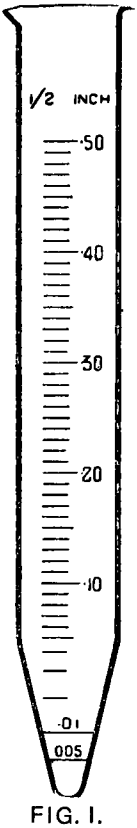

FIG. I.

Measuring glasses of a new pattern have recently been adopted by the Meteorological Office, and are now in use at certain official stations. The measure tapers at the lower end similarly to the Camden glass, but the walls are of uniform thickness throughout, so that the chief defect of the latter measure is overcome. Very fine limits have been laid down by the Meteorological Office with regard to the accuracy of the lower graduations, and it is possible to measure small quantities of rain accurately. A drawing of the new glass is shown in Fig. I.

It will be observed that the new measure is not provided with a base of any kind, a fact which might at first appear a disadvantage. It is intended that the measure should be held in the hand when taking a reading, as illustrated in Fig. II. In order to assist the observer to hold the glass vertically the graduations for each twentieth of an inch (each whole millimetre in the case of the millimetre measure) are reproduced on the back of the glass, the lower graduations (·01 in. and ·005 in.) extending completely round the measure. The risk of error from lack of verticality is actually less than in the case of the ordinary glass which may not stand vertical on its base, or which may be placed for reading on a table or support which is not level. If it were found desirable to support the glass in some way when pouring in the rain from the container of the gauge, a brass ring fixed in a post about three feet in height near (but not too near) the raingauge would serve. The open end of the measure is splayed sufficiently to allow this to be done. The measure can be conveniently stored when not in use by inverting it on a fixed vertical peg in a protected position. The risk of breakage is thereby minimised. Observers who have not used a measure with the ·005 in. graduation before should note that an entry ·005 should not be made in the register. If when the rainwater is poured into the measure the bottom of the meniscus is below ·005 the appropriate entry is " trace," when above the mark the entry is ·01. Doubtful cases are rare, the rule is to give the rain the benefit of the doubt and enter ·01.

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FIG. 11.—THE NEW TAPERED RAIN MEASURE IN USE.

Rainfall observers who report to the Meteorological Office can now obtain measures of the new type on application to the Director. The price of a new measure (graduated in inches or millimetres) for a 5 in. gauge is 6s. 1d., plus 9d. the cost of postage.

Probability Paper

WHILST it is well known that the distribution of many meteorological elements obeys more or less closely the law of errors, verification in particular instances is troublesome. It is interesting to notice that in discussing, in the *Monthly Weather Review* for March, 1924, " The Frequency of Winds of Different Speeds at Flying Levels between New York and Chicago," the authors, W. R. Gregg and J. P. Van Zandt, utilise " Probability Paper " to show that the west to east component of the wind is characterised by such a distribution. The mean component is 7·4 miles per hour from west, and half of the components are between 18·3 m.p.h. from west and 3·5 m.p.h. from east. The illustration of probability paper bears the name of the General Electric Company. Is such paper to be obtained in this country ?

Obituary

WE regret to learn of the death of Mr. C. Percival Bolton of Brook Lodge, Waterford, in July last. Mr. Bolton had maintained observations of rainfall at Brook Lodge since 1875, and the record has been published in this magazine since March, 1881. His sister, Miss Bolton, has offered to continue the rainfall observations, and the monthly total appears again in this number.

The Weather of August, 1924

THE weather during August was mainly cool and unsettled, with westerly winds. At the beginning of the month rain fell generally over the whole country, but this was followed by a short spell of anticyclonic conditions from the 6th to the 10th, during which period 13 and 14 hours of bright sunshine were registered daily at several stations. At a few places in the north-eastern counties the week ending the 9th was rainless. On the 11th, the approach of a depression south of Iceland caused a renewal of unsettled weather on the western seaboard and this subsequently spread south-eastwards. For the rest of the month pressure continued generally low in the north and north-west, and rain fell repeatedly over the whole country. The most noteworthy depression of the month was the one which crossed Ireland and England in an easterly direction on the 17th, causing

high winds or gales in the English Channel and some other parts of our coasts and subsequently followed an unusual track, moving north-westwards from the North Sea and then returning slowly first south then east across Scotland to the North Sea.

There was a comparatively small range of temperature, the deviation from the average being much more marked by day than by night. 79° F. was the highest temperature recorded during the month and this occurred in London on only one day, the 11th. The night of the 4th to 5th was very warm in many parts of England, temperature not falling below 60° F. at some stations. Ground frosts occurred at isolated places on a few nights.

The total rainfall for the month was very variable, some places having less than their average amount while a few had more than twice their average. Among the heaviest total falls were 457 mm. (18 ins.) at The Stye, Seathwaite, 335 mm. (13·19 ins.) at Delphi Lodge, Mayo, and 305 mm. (12·01 ins.) at Llyn Fawr, Glamorgan. It was, however, largely due to the frequency of precipitation rather than its magnitude that the month seemed so unusually wet, though at a few places there were heavy falls, mainly associated with thunderstorms. On the 19th in particular torrential rain and hail were experienced at Cannington (Somerset), when the observer at Brymore House measured 230 mm. (9·04 ins.) in the 24 hours (see p. 187).

During the first half of August mainly fair weather prevailed over Europe with thunderstorms in many districts. On the 7th a violent thunderstorm broke over the central plateau and eastern departments of France, interrupting communications and causing much damage to the harvest and vineyards. Temperature was rather high at the beginning of the month, but on the twelfth the weather changed for the worst, and remained unsettled until the end of the month, most places having lower temperatures and more rain than usual. However, in parts of Spain, the drought continued; Madrid itself on the 16th had been 100 days without rain. The crops in Andalusia, Aragon and Catalonia are reported to be failures through lack of rain. In Finland also owing to the heat and drought considerable areas of forest were burning. At the beginning of the month, the river Isar was in flood near Munich, and in southern Poland the floods destroyed a number of bridges and houses. Hungary reports that the wine crop wi l be far below the average this year owing to unfavourable weather, but the other crops are mostly normal. The severe weather in Switzerland continued, and a party of tourists were weather-bound on the Matterhorn from the 10th to the 15th. On the 28th fresh snow was covering the Bernese Oberland down to 3,000 ft., and the thermometer fell

to freezing point at Davos and St. Moritz on the 29th. Very heavy rainfall was reported from the districts round Lakes Maggiore and Varese on the 15th. In the central and southern districts of Norway floods have done great damage and a number of people have been rendered homeless.

In India, the rains in Madras have caused considerable floods, and large areas have been inundated. At Mercara, the capital of Coorg, the rainfall for June and July was over 100 inches, 24 inches falling on one day alone. In Bombay, where the harvest was threatened by drought, moderate rains have eased the situation. The reports concerning the floods in China show that intermittent rain continued to augment the area already covered with water, but that the pressure on Tientsin has been eased (see p. 189). Floods are also reported from Formosa, where 700 people have been drowned.

The eastern United States suffered from a heat wave at the beginning of August, Washington having a maximum temperature of 102° F. on the 6th. Destructive thunderstorms were reported from many districts. Owing to the heat and lack of rain in the south-eastern States the outlook for the cotton crop is unfavourable. During the evening of the 26th a hurricane swept the western Atlantic and several liners reported injuries to passengers and damage to the ships. During the 28th-29th another hurricane swept the Leeward Islands. Enormous damage was done to property and to crops and there were more than one hundred casualties.

From Australia comes the news that splendid rains have fallen on the wheat areas. The rain was less welcome as floods followed in the low-lying districts of Victoria.

The special message from Brazil, states that the winter rains were plentiful in the north-east, being 62 mm. above the normal for the month, but that elsewhere the rainfall was scanty, being 20 mm., 25 mm. and 60 mm. below normal in the northern, central and southern districts respectively. Temperature was 3·6° F. below the normal, a cold spell having occurred in the middle of the month. Many well developed anticyclones continued to cross the country quickly. The lack of rain and unusually low temperature have been very unfavourable for the cane and coffee crops. Pressure at Rio de Janeiro was 3·6 mb. above normal and temperature 1° F. below normal.

Rainfall August, 1924: General Distribution

England and Wales	114	per cent. of the average 1881-1915.
Scotland	113	
Ireland	112	
British Isles	113	

Rainfall: August, 1924: England and Wales.

CO.	STATION.	In.	mm.	Per-cent. of Av	CO.	STATION.	In.	mm.	Per-cent. of Av.
Lond.	Camden Square.....	2·72	69	123	*War.*	Birminghm, Edgbaston	3·50	89	129
Sur .	Reigate, Hartswood...	3·74	95	163	*Leics*	Leicester Town Hall...	2·53	64	...
Kent.	Tenterden, View Tower	3·12	79	136	,, .	Belvoir Castle.....	2·66	68	102
,, .	Folkestone, Boro. San.	3·52	89	...	*Rut .*	Ridlington.....	2·24	57	...
,, .	Broadstairs	1·70	43	82	*Linc.*	Boston, Skirbeck	1·99	51	83
,, .	Sevenoaks, Speldhurst.	2·85	72	...	,, .	Lincoln, Sessions House	2·85	72	116
Sus .	Patching Farm.....	3·47	88	138	,, .	Skegness, Estate Office.	1·80	46	74
,, .	Eastbourne, Wilm. Sq.	3·34	85	135	,, .	Louth, Westgate	1·93	49	69
,, .	Tottingworth Park....	5·28	134	196	,, .	Brigg	2·18	55	78
Hants	Totland Bay, Aston...	2·59	66	116	*Notts.*	Worksop, Hodsock....	3·17	81	129
,, .	Fordingbridge, Oaklnds	3·09	79	117	*Derby*	Mickleover, Clyde Ho..	3·27	83	120
,, .	Portsmouth, Vic. Park.	2·61	66	117	,, .	Buxton, Devon. Hos...	8·04	204	184
,, .	Ovington Rectory	2·67	68	99	*Ches.*	Runcorn, Weston Pt...	5·57	141	155
,, .	Grayshott	3·03	77	108	,, ..	Nantwich, Dorfold Hall	4·23	107	...
Berks	Wellington College...	2·67	68	115	*Lancs*	Bolton, Queen's Park .	8·53	216	...
,, .	Newbury, Greenham..	2·36	60	90	,, ..	Stonyhurst College....	7·54	191	149
Herts.	Bennington House....	1·92	49	79	,, ..	Southport, Hesketh...	4·44	113	128
Bucks	High Wycombe	2·81	71	121	,, ..	Lancaster, Strathspey.	4·66	118	...
Oxf..	Oxford, Mag. College..	2·05	52	91	*Yorks*	Sedbergh, Akay	4·64	118	83
Nor .	Pitsford, Sedgebrook..	2·00	51	83	,, .	Wath-upon-Dearne ...	2·81	71	117
,, .	Eye, Northolm.....	1·48	38	...	,, .	Bradford, Lister Pk...	2·86	73	111
Beds.	Woburn, Crawley Mill.	2·27	58	101	,, .	Oughtershaw Hall	6·74	171	...
Cam.	Cambridge, Bot. Gdns.	2·25	57	96	,, .	Wetherby, Ribston H..	4·79	122	175
Essex	Chelmsford, CountyLab	2·04	52	...	,, .	Hull, Pearson Park ...	2·33	59	80
,, .	Lexden, Hill House...	1·95	49	...	,, .	Holme-on-Spalding ...	2·90	74	...
Suff .	Hawkedon Rectory ...	2·44	62	94	,, .	Lowthorpe, The Elms.	1·92	49	70
,, .	Haughley House.....	2·85	72	...	,, .	West Witton, Ivy Ho..	1·81	46	...
Norf.	Beccles, Geldeston....	1·81	46	84	,, .	Pickering, Hungate ...	2·69	68	...
,, .	Norwich, Eaton	2·39	61	101	,, .	Middlesbrough	3·32	84	121
,, .	Blakeney	1·77	45	78	,, .	Baldersdale, Hury Res.	1·99	51	57
,, .	Swaffham	2·37	60	91	*Durh.*	Ushaw College	2·44	62	84
Wilts.	Devizes, Highclere....	2·86	73	99	*Nor .*	Newcastle, Town Moor.	3·27	83	112
Dor .	Evershot, Melbury Ho.	2·77	70	88	,, .	Bellingham Manor....	2·64	67	...
,, .	Weymouth, Westham..	2·30	58	107	,, .	Lilburn Tower Gdns...	1·85	47	...
,, .	Shaftesbury, Abbey Ho.	3·71	94	127	*Cumb*	Penrith, Newton Rigg..	2·21	56	62
Devon	Plymouth, The Hoe...	2·92	74	98	,, .	Carlisle, Scaleby Hall .	3·79	96	92
,, .	Polapit Tamar	4·97	126	156	,, .	Seathwaite	10·20	259	88
,, .	Ashburton, Druid Ho..	4·38	111	117	*Glam.*	Cardiff, Ely P. Stn.....	6·09	155	141
,, .	Cullompton	4·23	107	139	,, .	Treherbert, Tynywaun	11·27	286	...
,, .	Sidmouth, Sidmount ..	3·52	89	125	*Carm*	Carmarthen Friary....	5·39	137	116
,, .	Filleigh, Castle Hill ...	7·35	187	...	,, .	Llanwrda, Dolaucothy.	8·53	217	155
,, .	Hartland Abbey.....	4·06	103	...	*Pemb*	Haverfordwest, Portf'd	4·42	112	106
Corn.	Redruth, Trewirgie ...	3·30	84	96	*Card.*	Gogerddan.....	6·85	174	141
,, .	Penzance, Morrab Gdn.	2·57	65	81	,, .	Cardigan, County Sch. .	3·65	93	...
,, .	St. Austell, Trevarna..	4·58	116	126	*Brec .*	Crickhowell, Talymaes	6·00	152	...
Soms	Chewton Mendip	6·04	153	135	*Rad .*	Birm. W. W. Tyrmynydd	6·35	161	118
,, .	Street, Hind Hayes ...	5·91	150	...	*Mont.*	Lake Vyrnwy	6·64	169	128
Glos..	Clifton College	4·69	119	134	*Denb.*	Llangynhafal	3·89	99	...
,, .	Cirencester	4·00	102	130	*Mer .*	Dolgelly, Bryntirion..	9·64	245	171
Here .	Ross, County Obsy.	3.02	77	118	*Carn.*	Llandudno	3·06	78	101
,, .	Ledbury, Underdown.	3·45	88	132	,, .	Snowdon, L. Llydaw 9	22·95	583	...
Salop	Church Stretton.....	3·74	95	115	*Ang .*	Holyhead, Salt Island.	3·13	79	98
,, .	Shifnal, Hatton Grange	3·42	87	122	,, .	Lligwy	3·41	87	...
Staff.	Tean, The Heath Ho...	4·98	126	143	*Isle of Man*				
Worc.	Ombersley, Holt Lock.	3·00	76	112		Douglas, Boro' Cem...	5·48	139	141
,, .	Blockley, Upton Wold.	3·01	77	102	*Guernsey*				
War.	Farnborough.....	3·62	92	133		St. Peter Port Grange.	2·85	72	121

Rainfall: August, 1924: Scotland and Ireland

CO.	STATION	In.	mm.	Per-cent. of Av.	CO.	STATION.	In.	mm.	Per-cent. of Av.
Wigt.	Stoneykirk, Ardwell Ho	3·64	93	97	*Suth.*	Loch More, Achfary...	7·62	193	130
,, .	Pt. William, Monreith .	4·02	102	...	*Caith*	Wick	2·30	58	84
Kirk.	Carsphairn, Shiel.	6·66	169	...	*Ork .*	Pomona, Deerness	3·12	79	109
,, .	Dumfries, Cargen.....	4·67	119	106	*Shet .*	Lerwick	1·74	45	58
Dum	Drumlanrig	4·41	112	104					
Roxb	Branxholme	3·02	77	94	*Cork.*	Caheragh Rectory	4·36	111	...
Selk .	Ettrick Manse.....	4·73	120	...	,, ..	Dunmanway Rectory.	3·52	89	75
Berk.	Marchmont House	3·61	92	109	,, ..	Ballinacurra	1·97	50	53
Hadd	North Berwick Res....	2·55	65	81	,, ..	Glanmire, Lota Lo. ...	2·40	61	66
Midl	Edinburgh, Roy. Obs..	3·05	77	104	*Kerry*	Valencia Obsy.	5·03	128	105
Lan .	Biggar	2·97	75	89	,, .	Gearahameen	5·50	140	...
Ayr .	Kilmarnock, Agric. C..	4·13	105	105	,, .	Killarney Asylum.....	5·67	144	128
,, .	Girvan, Pinmore.....	4·64	118	104	,, .	Darrynane Abbey	5·23	133	120
Renf.	Glasgow, Queen's Pk..	3·10	79	88	*Wat .*	Waterford, Brook Lo..	2·72	69	71
,, .	Greenock, Prospect H..	3·80	97	70	*Tip .*	Nenagh, Cas. Lough...	2·61	66	66
Bute.	Rothesay, Ardencraig.	5·16	131	106	,, .	Tipperary	4·13	105	...
,, .	Dougarie Lodge	4·96	126	...	,, .	Cashel, Ballinamona ..	3·44	87	97
Arg .	Glen Etive.....	...	...	...	*Lim .*	Foynes, Coolnanes	4·55	116	118
,, .	Oban	5·43	138	...	,, .	Castleconnell Rec.	5·56	141	...
,, .	Poltalloch	6·54	166	133	*Clare*	Inagh, Mount Callan ..	8·97	228	...
,, .	Inveraray Castle.....	...	...	...	,, .	Broadford, Hurdlest'n.	5·21	132	...
,, .	Islay, Eallabus.....	6·40	163	147	*Wexf*	Newtownbarry	3·61	92	...
,, .	Mull, Benmore	15·50	394	...	,, .	Gorey, Courtown Ho...	2·80	71	84
Kinr.	Loch Leven Sluice	3·06	78	80	*Kilk.*	Kilkenny Castle	2·87	73	82
Perth	Loch Dhu	5·25	133	78	*Wic .*	Rathnew, Clonmannon	1·91	49	...
,, ..	Balquhidder, Stronvar.	5·03	128	83	*Carl .*	Hacketstown Rectory .	4·19	106	103
,, ..	Crieff, Strathearn Hyd.	4·35	111	103	*QCo..*	Blandsfort House.....	3·50	89	89
,, ..	Blair Castle Gardens ..	4·78	121	...	,,	Mountmellick	3·61	92	...
,, .	Coupar Angus School..	3·07	78	93	*KCo.*	Birr Castle.....	3·77	96	99
Forf.	Dundee, E. Necropolis.	2·88	73	85	*Dubl.*	Dublin, FitzWm. Sq...	3·02	77	99
,, .	Pearsie House.....	4·39	111	...	,, .	Balbriggan, Ardgillan .	4·12	105	121
,, .	Montrose, Sunnyside..	3·76	95	135	*Me'th*	Drogheda, Mornington	3·78	96	...
Aber.	Braemar Bank	3·47	88	103	*W.M*	Mullingar, Belvedere .	3·92	100	94
,, .	Logie Coldstone Sch. ..	6·24	159	197	*Long*	Castle Forbes Gdns....	5·18	132	127
,, .	Aberdeen, Cranford Ho	2·75	70	95	*Gal .*	Galway, Waterdale ...	...	...	...
,, .	Fyvie Castle	5·95	151	...	,, .	Ballynahinch Castle ..	7·60	193	...
Mor .	Gordon Castle.....	5·05	128	159	*Mayo*	Mallaranny.....	9·53	242	...
,,	Grantown-on-Spey....	6·15	156	192	,, .	Westport House.....	5·83	148	144
Na .	Nairn, Delnies.....	4·68	119	194	,, .	Delphi Lodge	13·19	335	...
Inv..	Ben Alder Lodge	4·52	115	...	*Sligo*	Markree Obsy.	7·91	201	183
,, .	Kingussie, The Birches	4·13	105	...	*Ferm*	Enniskillen, Portora ..	...	...	...
,, .	Fort Augustus	3·95	100	114	*Arm.*	Armagh Obsy.	4·42	112	122
,, .	Loch Quoich, Loan....	8·20	208	...	*Down*	Warrenpoint	4·74	120	...
,, .	Glenquoich	7·01	178	85	,, .	Seaforde	3·93	100	105
,, .	Inverness, Culduthel R.	4·43	112	...	,, .	Donaghadee	3·31	84	100
,, .	Arisaig, Faire-na-Squir	7·11	181	...	,, .	Banbridge, Milltown .	5·13	130	147
,, .	Fort William.....	6·38	162	104	*Antr.*	Belfast, Cavehill Rd. ..	5·44	138	...
,, .	Skye, Dunvegan.....	6·04	153	...	,, .	Glenarm Castle.....	4·17	106	...
,, .	Barra, Castlebay	3·57	91	...	,, .	Ballymena, Harryville	6·45	164	151
R&C	Alness, Ardross Cas. ..	4·59	117	156	*Lon .*	Londonderry, Creggan	6·89	175	149
,, .	Ullapool.....	8·12	206	...	*Tyr .*	Donaghmore	4·87	124	...
,, .	Torridon, Bendamph..	7·00	178	106	,, .	Omagh, Edenfel	6·64	169	155
,, .	L. Carron, Plockton...	...	...	...	*Don .*	Malin Head	5·04	128	143
,, .	Stornoway	...	...	...	,, .	Rathmullen.....	6·54	166	...
Suth.	Lairg	5·42	138	...	,, .	Dunfanaghy	4·51	115	102
,, .	Tongue Manse.....	5·87	149	183	,, .	Narin, Kiltoorish	6·33	161	...
,, .	Melvich School.....	4·44	113	149	,, .	Killybegs, Rockmount.	10·34	263	184

Climatological Table for the British Empire, March, 1924

STATIONS	PRESSURE		TEMPERATURE							Relative Humidity	Mean Cloud Am'nt	PRECIPITATION			BRIGHT SUNSHINE	
			Absolute		Mean Values				Mean							
	Mean of Day M.S.L.	Diff. from Normal	Max.	Min.	Max.	Min.	½ max. and min.	Diff. from Normal	Wet Bulb.			Am'nt	Diff. from Normal	Days	Hours per day	Percentage of possible.
	mb.	mb.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	%	0—10	mm.	mm.			
London, Kew Obsy. ..	1012·3	— 1·1	58	26	48·6	33·8	41·2	— 1·2	38·6	75	5·4	21	— 22	8	5·0	42
Gibraltar	1013·6	— 3·4	68	43	60·5	53·5	57·0	— 0·5	53·9	82	8·3	250	+128	26	...	...
Malta	1014·4	+ 0·5	68	44	60·7	51·8	56·3	+ 0·2	52·7	83	5·5	38	+ 4	10	5·9	50
Sierra Leone	1010·4	— 0·5	94	72	90·6	74·9	82·7	0·0	75·9	69	2·8	24	— 4	2	...	...
Lagos, Nigeria	1008·0	— 1·4	93	72	90·7	78·2	84·5	+ 1·6	81·0	77	5·5	134	+ 38	5	...	...
Kaduna, Nigeria	1011·1	0·0	100	...	97·2	...	...	...	71·0	53	0·8	7	— 3	2	...	...
Zomba, Nyasaland ...	1010·2	+ 0·5	87	61	81·8	65·3	73·5	+ 2·8	...	89	7·7	145	— 65	17	...	...
Salisbury, Rhodesia ..	1009·5	— 1·9	87	55	81·2	59·9	70·5	+ 2·4	63·7	68	4·5	87	— 20	14	...	...
Cape Town	1014·9	+ 0·4	91	51	75·0	56·6	65·8	— 2·4	59·8	63	3·8	19	— 5	6	...	...
Johannesburg	1014·7	+ 0·8	82	43	69·5	55·4	62·5	— 0·8	56·9	83	7·4	159	+ 52	18	4·5	37
Mauritius	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Bloemfontein	...	...	91	45	76·2	57·1	66·7	— 0·7	60·3	81	3·0	175	+ 74	15	...	...
Calcutta, Alipore Obsy.	1010·1	+ 0·2	102	61	97·4	70·8	84·1	+ 4·0	69·6	72	1·5	0	— 32	0*	...	...
Bombay	1010·0	— 0·7	94	71	89·3	75·7	82·5	+ 3·0	72·7	69	1·6	0	— 1	0*	...	...
Madras	1011·1	+ 0·2	95	64	90·7	71·5	81·1	+ 0·1	74·7	76	2·4	3	— 2	1*	...	...
Colombo, Ceylon	1009·7	— 0·3	93	67	89·2	73·6	81·4	— 0·6	77·4	66	5·4	287	+175	12	7·6	63
Hong Kong	1017·6	+ 1·8	75	52	67·0	59·2	63·1	— 0·2	58·7	79	8·0	5	— 71	8	4·3	36
Sandakan	...	...	89	73	86·6	76·3	81·5	+ 0·4	76·9	77	...	164	— 42	8	...	...
Sydney	1016·1	— 0·1	91	56	76·3	62·5	69·4	+ 0·2	63·2	68	5·8	107	— 23	11	6·3	51
Melbourne	1016·4	— 0·6	91	45	72·9	54·2	63·5	— 1·0	58·3	65	5·9	147	+ 90	8	6·1	50
Adelaide	1016·9	— 0·1	95	49	77·8	56·3	67·1	— 2·8	58·2	53	4·4	53	+ 27	6	6·6	54
Perth, W. Australia ...	1016·4	+ 1·0	96	50	80·2	59·6	69·9	— 1·0	59·9	53	3·3	10	— 8	3	8·0	65
Coolgardie	1016·9	+ 2·1	97	47	79·9	56·9	68·4	— 3·3	59·1	46	4·5	45	+ 26	7	...	...
Brisbane	1014·6	+ 0·5	91	59	82·9	65·8	74·3	— 0·1	68·9	68	4·4	88	— 62	10	8·0	65
Hobart, Tasmania	1015·2	+ 1·2	84	42	67·3	52·1	59·7	+ 0·3	54·9	71	6·4	67	+ 24	16	6·1	50
Wellington, N.Z.	1020·5	+ 3·5	76	46	68·1	56·2	62·1	+ 1·4	57·6	75	6·3	121	+ 38	13	4·7	38
Suva, Fiji	1007·6	— 0·9	93	71	86·0	74·1	80·1	0·0	76·9	84	6·3	349	— 24	23	...	...
Kingston, Jamaica ...	1013·3	— 1·6	92	61	87·1	69·2	78·1	+ 1·0	70·7	65	3·3	5	— 21	4	...	...
Grenada, W.I.	1013·7	+ 0·8	87	71	84·2	72·9	78·5	+ 0·8	72·6	70	2·9	10	— 60	5	...	...
Toronto	1011·8	— 5·2	51	10	37·2	26·0	31·6	+ 2·7	27·3	61	6·3	20	— 47	11	4·6	39
Winnipeg	1021·1	+ 2·3	46	2	33·0	14·8	23·9	+ 9·5	21·0	71	4·4	2	— 25	3	5·5	47
St. John, N.B.	1004·1	—10·1	50	7	36·9	25·2	31·1	+ 2·7	28·4	74	7·2	56	— 59	14	4·0	34
Victoria, B.C.	1017·8	+ 2·0	57	31	51·1	38·9	45·0	+ 1·8	40·6	78	4·9	15	— 50	10	5·8	49

* For Indian stations a rain day is a day on which 0·1 in. (2·5 mm.) or more rain has fallen.

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The Circulation of Atmospheric Electricity: Some New Evidence

By F. J. W. WHIPPLE, M.A., F.Inst.P.

IN 1923 Mr. S. J. Mauchly, of the Carnegie Institution at Washington, published* an important paper on the diurnal variation of the potential gradient of atmospheric electricity. This paper was devoted in the first instance to the results obtained on the "Carnegie," the non-magnetic vessel which is used for oceanic surveys. Mauchly demonstrates that the regular variations in potential gradient are simultaneous over the Atlantic, Indian and Pacific Oceans. The maximum gradient occurs in the evening over the Atlantic, in the morning over the Pacific, in either case at about 20h. by Greenwich Mean Time. Similarly with the minimum which occurs at about 3h. G.M.T. The number of the observations on which these conclusions are based is small, for the averages are confined to days free from rain and other interruptions. In our diagram the diurnal variation over the oceans is shown. For comparison we have also reproduced the curves† for Dr. Simpson's observations in Lapland, at Karasjok, and in the Antarctic at Cape Evans. The Antarctic curve has been regarded as anomalous hitherto

* On the Diurnal Variation of the Potential Gradient of Atmospheric Electricity. By S. J. Mauchly. *Terrestrial Magnetism and Atmospheric Electricity*, Vol. xxviii., Sept. 1923, p. 61.

† British Antarctic Expedition, 1910-1913. Meteorology by G. C. Simpson, F.R.S., Vol. I, Discussion pp. 315 and 319.

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(Dr. Simpson suggested that it might be significant that the station at Cape Evans was between the South Pole and the South Magnetic Pole) but the substitution of Greenwich Mean Time for local time brings it into agreement with that for Karasjok and also with Mauchly's curve.

Curves which represent the diurnal variation of potential gradient at most observatories differ considerably from those before us. There are as a rule two minima, one in the early morning and one in the afternoon. It is agreed that these features depend in part on the action of dust, smoke and cloud in the atmosphere. Meteorological conditions are much simpler near the poles and over the oceans. The daily changes in wind and temperature at sea are trifling and it is very unlikely that the variations in potential gradient are due to variations in the state of the atmosphere near sea level: if we may assume that the ionization and therefore the conductivity of the air is steady then the potential gradient is a measure both of the current flowing from air to earth and of the potential difference between the earth and the atmosphere at great heights.

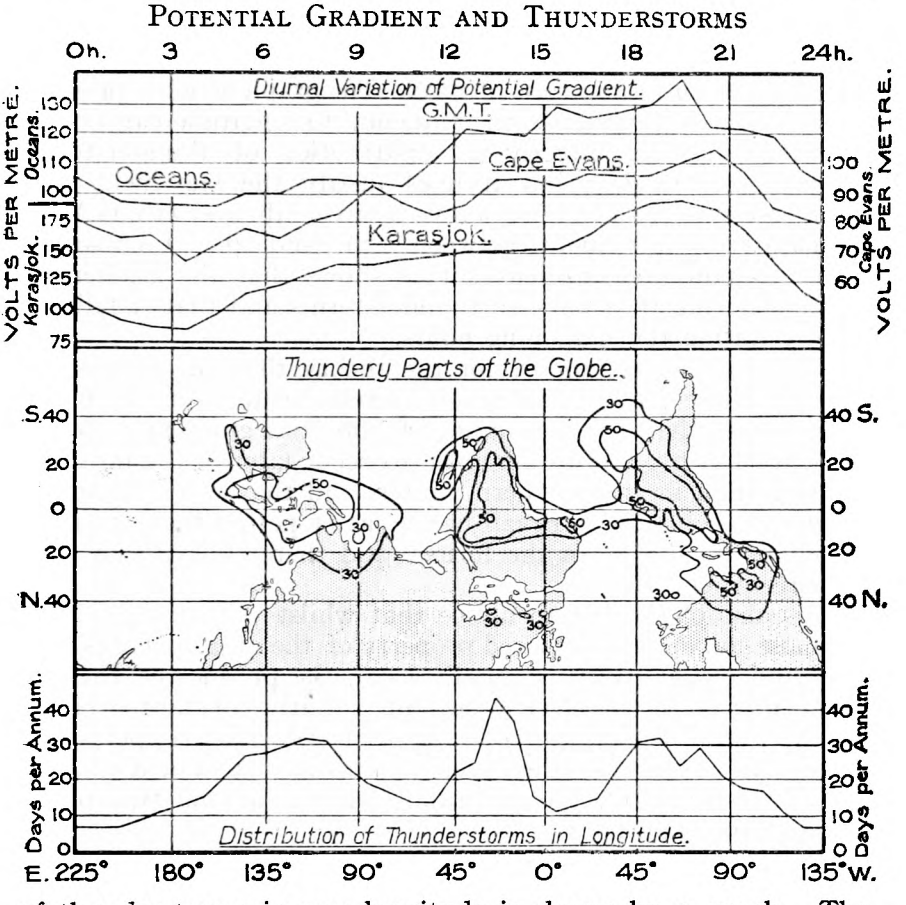
Accordingly Mauchly's investigations lead us to the idea that over the greater part of the globe there is a regular pulse in the flow of electricity. Near the ground the flow consists of an upward streaming of negative ions and a downward streaming of positive ions. It is this double flow which fluctuates in strength.

In looking for an explanation one naturally thinks of C. T. R. Wilson's suggestion* that the fine weather flow of atmospheric electricity is a bye-product of thunderstorms. There is much vagueness about the actual process, but we may accept provisionally the idea that on the balance a thunderstorm draws negative electricity from the upper atmosphere. As everyone who has dabbled in wireless telegraphy knows, there is good evidence for the upper atmosphere, say at 50 kilometres above the ground, being a comparatively good conductor; the electric current in the conducting layers consists according to Wilson's hypothesis in a flow of negative electrons from the fine areas to the thunderstorms.

The question now arises, when do thunderstorms occur. The tropical thunderstorm which comes almost with clockwork regularity day by day is always in the afternoon, and indeed in temperate regions also the afternoon is the most likely time for a storm. Let us take 3 p.m. as the representative hour for each place. The map reproduced in our diagram is drawn so as to indicate the hour by Greenwich Time corresponding with 3 p.m. local time. As the sun's motion relative to the earth is from east to west and as in drawing graphs we put late to the right

* Dictionary of Applied Physics, 1923, Vol. III., p. 104.

of early, we have here put west to the right of east and therefore drawn the map with south at the top. It will be seen that at Cape Horn 3 p.m. is 19h. 30m. G.M.T., in New Zealand 3 p.m. is 3h. 30m. G.M.T. The areas in which the annual frequency of thunderstorms exceeds 30 and those in which it exceeds 50 are shown* on the map. Below the map the average frequency



of thunderstorms in any longitude is shown by a graph. The average refers to places between 60° N and 50° S. Thunderstorms are comparatively frequent in the longitudes of the East Indies, Africa and south America, infrequent over the Oceans. The special point to notice is that the Pacific Ocean is much wider than the others.

Thunderstorms may be divided roughly into three classes; those which are associated with local heating of the land; those which are associated with the flow of cold air over warm water; those which are associated with the conjunction of air currents

* I have to thank Mr. C. E. P. Brooks for the statistics.

from different regions. Storms of the first class occur mainly in the afternoon hours. Those of the second class are most likely to occur in the early morning when clouds as they form are cooled by radiation. Statistics computed by Meinardus for the Indian Ocean, and by Buchan for the Challenger expedition, shew that this type of diurnal variation is characteristic of the oceans. From our present point of view the important point to notice is that the morning storms on the Pacific synchronize with the afternoon storms in Africa. The storms of the third class may occur at any time of day. The graph which represents the relation of thunderstorm frequency to longitude can not be regarded as giving directly the distribution of thunderstorms throughout the day, but it does justify the statement that thunderstorms are most numerous between 4h. and 21h. G.M.T., comparatively infrequent between 21h. and 4h. Comparison with the potential gradient curves shows that the gradient is growing during the hours of thunderstorms and that it falls off rapidly during the remaining hours.

Some additional support for the theory that the connection between these phenomena is not merely casual is to be found in the facts that the maximum of potential gradient is found both by Mauchly and by Simpson to occur later in the northern summer than in the northern winter, and that whilst thunderstorms are common in Brazil in the latter period they are more numerous in Mexico in the former, and therefore an hour later by Greenwich Time.

It is also of interest to notice that whilst potential gradient, the most commonly measured property of the atmosphere is very local and conductivity is equally local, the product of the two which represents the electric current is fairly constant over the globe. Angenheister* gives 2·2 and 1·8 microampères per square kilometre as the average current at Potsdam and Samoa respectively, the potential gradient at the two places being in the ratio 6 : 1

It is only fair to mention in conclusion that various theories other than the thunderstorm one have been put forward tentatively in explanation of the fact that in fine weather the potential gradient is positive and the earth is negatively charged. The thunderstorm theory has now the advantage of fitting in with the records of diurnal variation. The outstanding difficulty is to explain why a thunderstorm should pump electrons downwards from the upper conducting layer rather than upwards into that layer.

*Die Luftelektrischen Beobachtungen am Samoa-Observatorium, 1906, 1907, 1908, by G. Angenheister. *Abhandlurgen der Königlichen Gesellschaft der Wissenschaften zu Gottingen. Mathematioch-Physikalische Klasse. Neue Folge. Band IX. Nro. 2.*

The Unprecedented Rainfall at Cannington

By J. GLASSPOOLE, M.Sc.

IN view of the unprecedented nature of the rainfall of August 18th-19th at Cannington, in Somerset, between the Quantock Hills and the River Parrett, an inspection was authorised by the Director of the Meteorological Office, and, on September 16th, I visited the area affected by the floods.

Some details have already been given in this magazine.* The most important were :—

(1) the measurement of 9 inches of precipitation in one day at Brymore House near Cannington, the second largest fall ever recorded in one day in the British Isles.

(2) the estimate that 8½ in. of this precipitation fell in 4½ hours.

(3) the division of the area of damage done by flood into two areas—(*a*) from Stogursey to Cannington, and (*b*) on the Polden Hills.

(4) the recurrence of heavy rain in this district. On June 28th, 1917, the day of the Bruton floods, the measurement at Brymore House was 4·91 in.

The rain-gauge at Brymore House, which recorded 9 in., was especially examined. The gauge and measure were accurately graduated, the exposure was excellent and the gauge could not have been flooded. Mr. Kendall is to be congratulated on having taken every possible precaution to obtain an accurate reading. The next largest rain-gauge measurement is that of 5·6 in. at Ashford House. The large value at Brymore House is also confirmed by observations from cattle tubs and troughs; both at Cannington Park and at Farm near Fiddington measurements of about 10 in. were made. The map shows the probable distribution of the rainfall for the 24 hours from 9 a.m. (G.M.T.) on the 18th, the actual readings being indicated. Mr. Kendall reads his gauge each day at 8 a.m. (G.M.T.) His readings were 9·04 in. and ·75 in. for the 18th and 19th respectively. On the 19th, steady rain fell from 6.30 to 10 a.m. (G.M.T.) It is reasonable to take the fall for the 24 hours from 9 a.m. (G.M.T.) on the 18th as 9·40 in.

Mr. Kendall adheres to the estimate, that 8½ in. fell in 4½ hours from 2 to 6-30 a.m. (G.M.T.) on the morning of August 19th. Evidence from other sources leaves little doubt but that this is substantially correct. Some reports refer to heavy rain by 1.30 a.m. (G.M.T.), and others to heavy showers earlier. Probably there were variations in different localities. A conservative estimate is that at Brymore House at least 8 in. of rain fell in the 5 hours from 1.30 to 6.30 a.m. (G.M.T.) A comparison

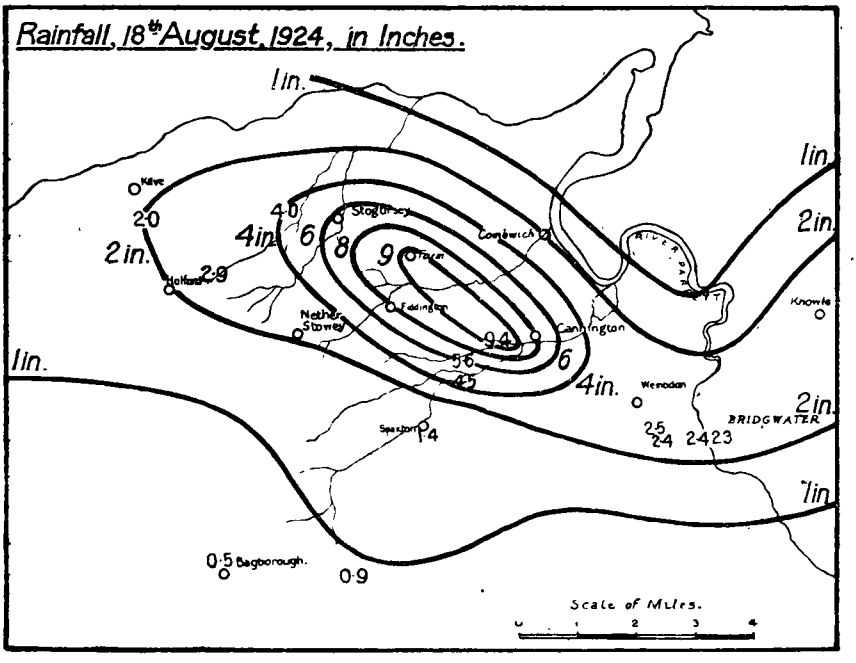
* Vol. 59, Sept., 1924, p. 187.

of these figures with those for other notable storms is not without interest :—

Cannington. Brymore House. Aug. 18th, 1924.	Louth. Elkington Hall. May 29th, 1920.	London. Campden Hill. June 16th, 1917.	Norwich. Ipswich Rd. Aug. 26th, 1912.
8 in.	4·59 in.	4·65 in.	4·90 in.
5 hr.	3 hr.	2½ hr.	6 hr.
1·6 in/hr.	1·5 in./hr.	1·9 in./hr.	0·8 in./hr.

This fall of 8 in. in 5 hours must therefore be regarded, when both the amount and the period are taken into account, as one of the most remarkable on record.

In the Polden Hill area, the contour of the land appears to have assisted the water in causing damage—the water ran rapidly

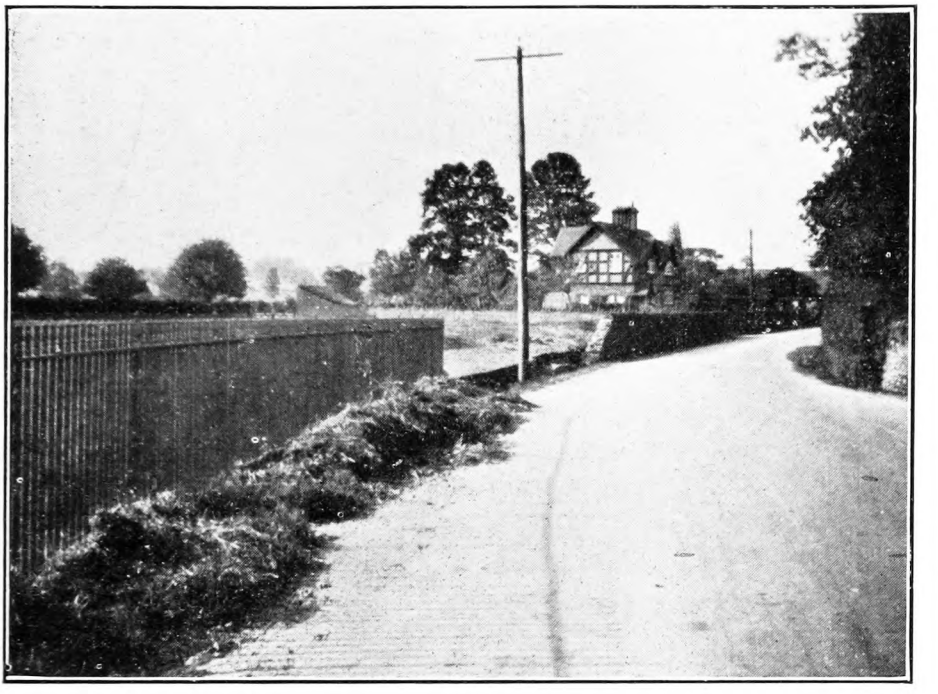


off the hills—and at Knowle the large amount of earth which had to be removed from the road was mainly due to the steepness of the bank. The largest actual rainfall measurement is 2·9 in. In the Cannington area there was a great deal of hail; probably one-third of the precipitation fell in this form. Much damage was done by the hail to plants and trees, especially the north-west sides, but the hail cannot have been unduly large for, so far as I am aware, no glass was broken.

During the storm, the rain flowed along the roads, which are generally below the surrounding fields. As a result, in many places the banks collapsed. The Engineer to the Bridgwater Rural District Council estimates that 2,000 tons of earth banks

[*To face page* 206.

DAMAGE DONE BY FLOODS AUGUST 19TH, 1924.
OPPOSITE BRYMORE LODGE.



AT EDBROOK FARM.

had to be removed from the roads in this area. I was particularly impressed with the damage done along the road from Fiddington through Edbrook Farm to Cannington. Similar denudation was done by the streams in their natural courses, but this is more difficult to estimate.

The map shows that the area of heavy rainfall is drained by three streams: One flowing direct to the sea, and the other two into the River Parrett. One of these drains the greater part of the Brymore Estate and flows through ponds there. These ponds filled and overflowed. The flood spread eastward, until it reached another stream of water running northward along the main road. There is a bend in the road here, as shown in the photograph, and some 30 yards of railings were blocked by straw, hedge trimmings, etc., and the water held up. Eventually the wall gave way in one solid block for 20 yards. The photograph shows the fallen wall as well as the remains of the obstruction at the foot of the railings. At this point the inhabitants of the one storey lodge of the Brymore Estate, to the right of the road in the photograph, were compelled to pull a table on the bed and remain on top of it for two hours until the water subsided. Some telegraph poles were carried over the hedge here.

At Fiddington, two interesting examples of the change of course in the stream are apparent:—

1. Formerly the stream flowed by the side of a pond, but when in flood some boulders, gravel, etc., were deposited as the stream broadened out here, and now the course is through the pond.

2. Further on, the deposit holds back the water to a greater depth and the bulk of it passes down a side stream, which previously was insignificant.

The lower photograph illustrates the damage done at Edbrook Farm. The water flowed on to the River Parrett, through Combwich, where much flooding occurred. The water ran over the top of the bridge and the stream rose no less than 6 feet within 20 minutes.

It is fortunate that this rain fell so near a large river and the sea. The damage must have been much greater if (1) the three streams had joined, (2) the country had been hilly, and (3) the streams had flowed through a town. Apparently the amount and intensity of the rainfall were greater at Cannington than in the disastrous Louth flood, when 22 people were drowned.

The first glider contests to be held in Italy opened on October 6th on the Sisemola Hills near Asiago. Unfortunately, only very light breezes (about 8 ft. per second) occurred on that day, so that few flights could be attempted.

Official Publications

The following publications have recently been issued :—

PROFESSIONAL NOTES—

No. 36. *On the Inter-Relation of Wind Direction with Cloud Amount and Visibility at Cahirciveen, Co. Kerry.* By L. H. G. Dines, M.A., A.M.I.C.E., and P. I. Mulholland, B.Sc. (M.O. 245p.)

Valencia Observatory, Cahirciveen, is maintained by the Meteorological Office as a post where the weather of the Atlantic seaboard can be studied. In this contribution to the series of *Professional Notes* the observations of cloud amount and of visibility are discussed. As was to be expected, the highest proportion of cloud occurs with winds from the Atlantic ; on the average, when there is a south wind at the Observatory, so that the drift of air at a moderate height is probably from south-west, 91 per cent. of the sky is covered with cloud. The clearest skies occur with calms in spring and with north-east winds in winter and autumn. As to visibility, we learn that dry winds from the north are most favourable, east and south-east winds the least.

The occurrence of reddish brown dust haze is systematically noted at the Observatory, and it is shown that such haze is to be attributed to smoke reaching the Irish coast from the English industrial districts, 350 miles away. Will there be a note in the *Meteorological Magazine* of 1934 recording the growing rarity of this phenomenon and attributing it to the restriction of atmospheric pollution ?

Book of Normals of Meteorological Elements for the British Isles for periods ending 1915. *Section* V. Monthly Normals for Rainfall Stations. (M.O. 236.)

The attention of readers of the *Meteorological Magazine* who are interested in rainfall observations is called to the publication by the Meteorological Office of the fifth section of the Book of Normals. In this section the average rainfall at each of 578 stations is given for each month of the year. The normals were computed in the British Rainfall Organization under the superintendence of Mr. Salter, whose death occurred when the work was practically completed.

The stations to which the statistics refer are generally such as were in continuous operation during the whole period of 35 years from 1881 to 1915, but in some cases it was found necessary to utilise observations covering a shorter period and make adjustments with the aid of the records of other stations.

There are practical advantages in the choice of the particular period 1881 to 1915 for the averages, and it is satisfactory to know that investigation has shown that these averages are in close agreement with those for very long periods to which the name "normals" is appropriate. To illustrate the way in which the stations are distributed we take as an example the County of Cumberland. There are 10 stations in the county. In the Lake District we find Seathwaite with a normal annual rainfall of 129 in., Wythburn with 88 in., and Lorton with 54 in. The coastal districts are represented by stations at Aspatria, Ravenglass and Whitehaven, each with an annual rainfall of about 42 in. Four stations in the Valley of the Eden have about 33 in. a year. The wettest month of the year is December except in the north of the county where August takes precedence. For Scaleby Hall, near Carlisle, the normals for the six wettest months are August 4·11, October 3·34, July 3·27, December 3·21, November 3·00, September 2·70. The driest month of the year is April except at Seathwaite and Wythburn where the minimum rainfall is in June.

A useful addendum to the tables for the individual stations is the table showing the average monthly rainfall for England, Wales, Scotland and Ireland. This table was computed by estimating the rainfall at numerous points uniformly distributed over the map.

The Observer's Primer, being short instructions on the method of taking and reporting readings of temperature and rainfall. (M.O. 266.)

These instructions which were prepared primarily for the use of meteorological observers in British Crown Colonies are written in simple language and will be of interest and value to those who wish to take observations for their own purposes. They are completed by a statement of the daily routine on a single sheet, which is to be cut out, pasted on a card and hung up for constant ready reference.

Errata

June, 1924, page 124, line 37, *for* "As in April numerous secondary depressions" *read* "Many anticyclones."

July, 1924, page 145, line 38, *for* "5° F." *read* "·5° F."

September, 1924, page 185, line 12 "for August 1924," *should read* "for September, 1924."

September, 1924, page 190. The first line should come at the bottom of the page.

Correspondence

To the Editor, *The Meteorological Magazine*

Precision in Rainfall Measurement

THE introduction of the new rain measure* is an immense step towards accuracy in the measurement of small amounts of rain. But there is a matter, closely connected with this refined measurement, to which, I believe, no attention has ever been given. The inside of the collecting bottle is always wet after draining it into the measure. If the bottle was dry inside when rain began to fall, a quantity of water, varying according to size of bottle from ·001 to ·003 in. of rain will be left as a film inside the bottle and lost to measurement. This quantity, by itself, is unimportant, but it may make all the difference between less or more than ·005, and therefore between recording a trace or a rain day. The remedy obviously is, always to wet the inside of the bottle which is to be placed in the gauge. I find by careful experiments that, if a small very accurately measured amount of water is put into a previously wetted bottle, I get the exact amount out when I drain the bottle into my measure. The most convenient way of working is to use two bottles; carry one, previously wetted and drained, to the gauge; substitute it for the bottle in the gauge, and carry the latter to the house, where it is so drained into the measure as to leave its interior in the same state of wetness as when it was placed in the gauge.

MORTYN J. SALTER.

Bank House, Mickleton, Campden, Gloucester. Sept. 16th, 1924.

[Mr. Salter's suggestion may be commended to observers though it seems doubtful whether it would secure the advantage he claims for it. As a general rule the bottle which had been wetted and drained would be dry before the next shower. On the other hand the convenience of having a spare receptacle to slip into the gauge when it happens to be raining at the observation hour is considerable.—ED. *M.M.*]

A Remarkable Thunderstorm

NOT seeing any notice of the remarkable thunderstorm which passed over West Kent on September 8th last, in your issue for September, I am venturing to send you a few notes thereon.

At 1 a.m. (G.M.T.) on September 8th, a storm of cyclonic violence burst suddenly over this district, and at this particular station (Hawkenbury, Tunbridge Wells), during the 15 minutes the storm lasted 0·58 in. of rain was deposited in the gauge.

* See the *Meteorological Magazine*, Vol. 59, Sept., 1924, p. 193.

The wind blew with great violence from the north-west, and the rain was intermixed with a great deal of hail. The lightning was practically incessant during the period named.

From reports from the surrounding districts, however, it would seem that Tunbridge Wells passed between two separate storms, as on the one side the hop-gardens in the neighbourhood of Tonbridge and Paddock Wood suffered severely from the effects of the high wind which unroofed "hoppers'" huts and did other widespread damage; whilst on the other side, at Frant and Wadhurst, horses were killed by lightning, and large oak-trees had their tops twisted completely off by the force of the wind, which was evidently of a cyclonic character. Trees were also damaged at Pembury.

Incidently I give the readings of instruments taken at 9 p.m. (G.M.T.) on the 7th, which show that the thunderstorm was of a "cyclonic" rather than of a "summer" nature. Bar. (corrected) 29·50 in., therm. 64° (during day max. temp. 68°, min. temp. 58°); wind S., force 0, cloud 10.

D. W. HORNER.

Sydenhurst, Tunbridge Wells. Sept. 30th, 1924.

The Control of Fire-Damp by Atmospheric Pressure

MARSH gas is met with in the Kimberley mines. It appears to be derived from the black shales in the country rock through which the diamond pipes penetrate. When the rock tunnel surrounding the Bultfontein Mine at the 1,000 foot level was being made it intersected, at one spot, a number of fissures which discharged the gas in quantities sufficient to be dangerous. Colonel Stokes has dealt with the situation by having a 2½ in. iron pipe cemented into one of the exposed fissures and sealing up all the others. The gas streaming out of the iron pipe is kept alight always, burning like a great torch without smoke. In case the flame should become extinguished at any time, compressed air is available with which to set up temporarily a sufficient circulation of air to clear the tunnel of most of the unburnt gas that might accumulate.

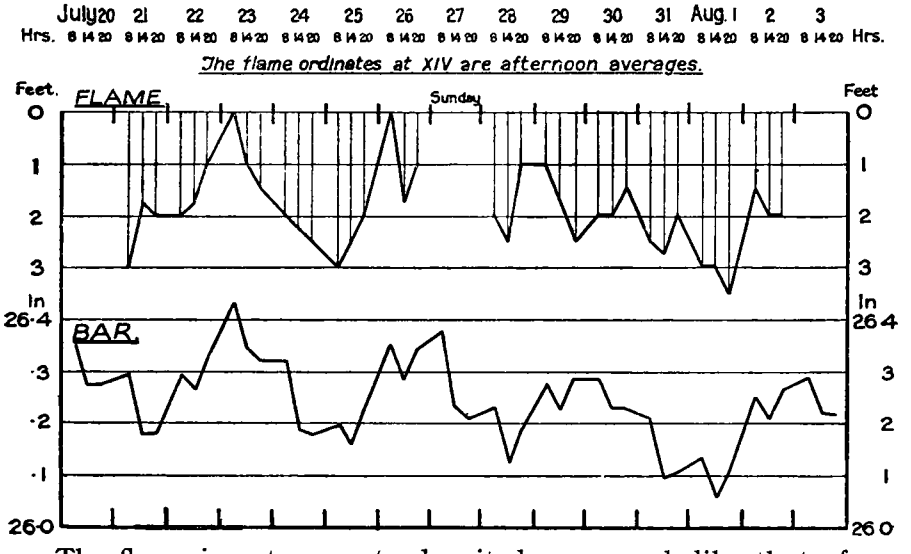
Mr. Parry's analysis of a sample of the gas gave the following result:—

	%		%
Methane ..	54·02	Oxygen	2·10
Nitrogen ..	43·36	Carbon Dioxide ..	0·52

To ensure that the gas should not be contaminated with the air of the tunnel a tube was inserted in the discharge pipe, and the gas was drawn from behind the flame through the tube.

The meteorological interest of the matter, is that the flame varies in length from time to time, from a few inches to a few feet according to the varying pressure of the air. The annexed

diagram shows how close the correspondence is between the estimated lengths of the flame and the air pressures as given by the observatory standard barometer at Kenilworth. When pressure is high the flame may die right away. This happened twice in the fortnight covered by the diagram. The longest flame observed came when the pressure was lowest of all. Moreover by taking flame-length averages a diurnal oscillation is indicated, the flame averaging longest in the afternoon and shortest in the morning, just when the air pressures are lowest and highest respectively. On the whole, a decrease of 0·10 in. of barometric pressure at the surface synchronises with an increase of one foot length of flame.



The flame is not very steady: it dances much like that of a wood fire in an open grate. But it is easy to make a fairly good estimate of its length and so of the relative gas pressure behind it. Later on we hope to replace estimates by accurate measurements. It is perhaps worth mention here that the estimates of length were made by one of the mine officials for record purposes only and not with any meteorological intention whatever. The relation shown by the diagram only came to light afterwards.

The fact that fire-damp in mines may be most dangerous when the barometer is low, or, rather, falling, is of course well known, and has been referred to in mining reports a multitude of times. But I do not remember a case in which the reported conditions have been as favourable as those at Bultfontein for getting a direct correlation between gas and pressure by simple routine observations.

J. R. SUTTON.

Kimberley, South Africa. Sept. 5th, 1924.

Bold Experiments in Physiological Optics

As there appears to be prevalent a belief that looking at the sun with the naked eye would be injurious to the optic nerve, I would say that for some years I have experimented with the sun by looking at it with the naked eye, and thus getting color impressions of that glowing orb. After gazing steadily for 30 seconds or more, and then closing the eyes, the red, orange and violet centre can be plainly seen. These colors blend and intermingle from time to time, but the violet and the green, the latter clearly being a blending of the violet and orange rays are the most persistent. On one occasion, on the 21st of June at 12 o'clock noon, I looked steadily at the sun for 15 minutes, changing from one eye to the other at intervals of about 30 seconds, and beyond making my eyes run there was no inconvenient effect. This was done while I was living in Atlanta, Ga., where the sun is fairly strong on the date given. As this took place 12 years ago, and, as at the age of 68 my sight is very good, I am sure that no one need to fear trying similar experiments. My own opinion is that what I have here described, repeated occasionally over a period of 20 years, has been beneficial rather than the reverse.

GEORGE LOWE.

84, Garner Avenue, Buffalo, U.S.A. August 29th, 1924.

The Indian Weather Review

FROM your remarks on the *India Weather Review* which appeared on p. 134 of the *Meteorological Magazine* for July, 1924, your readers may imagine that all the climatological data for Indian stations will in future be published together in annual volumes. I would point out, however, that most of the monthly figures now appear in the *Monthly Weather Report*, and that the two volumes, entitled *India Weather Review* for 1921 and 1922 respectively, were special publications intended to bridge the gap between the last *Monthly Weather Review*—that for December 1920—and the first *Monthly Weather Report*—that for January, 1923. A slip notifying these changes was issued with the last named report ; and they were also explained on page 1, paragraph 3 of the *Reviews* for 1921 and 1922.

C. W. B. NORMAND.

Indian Meteorological Department, Simla, Sept. *17th,* 1924.

THE American world flyers completed the circuit of the globe on September 28th, in the actual flying time of 367 hours, although nearly six months had elapsed since their departure from Seattle on April 6th.

NOTES AND QUERIES

Rain Gauges in the London Parks

METEOROLOGICAL observations are made regularly in several of the London Parks. The instruments are mounted on a stand in the form of a notice board with the rain-gauge on top. This type of exposure of a rain-gauge is unsatisfactory and the L.C.C. Parks Department, have now set up Snowdon rain-gauges with normal exposure. Readings from these gauges are entered on charts displayed in prominent positions. The parks concerned are: Battersea Park, Brockwell Park, Golder's Hill, Island Gardens, Telegraph Hill, Southwark Park and Victoria Park. It is usually difficult to obtain good open exposures in towns and this series of observations, with standard gauges, is therefore of importance.

Crop-Weather Stations

THE Ministry of Agriculture and Fisheries and the Board of Agriculture for Scotland, acting in co-operation with the Meteorological Office, has recently set on foot a scheme for the correlation of meteorological data with the growth of crops. Twenty stations in England and Wales and two in Scotland are to work under this scheme. At each of these places which consist of agricultural or horticultural colleges or experimental farms, a climatological station is being established. The normal equipment of a climatological station has been installed; special stress is laid on observations of earth temperature, thermometers at 4 in. and 8 in. being used. Anemometers are also being provided in cases where the work is horticultural in character. At a few of the stations, *e.g.* Rothamsted, meteorological work has already been carried out for many years.

In connection with the scheme a course of meteorological instruction was held at Kew Observatory on the four days, September 23rd to 26th inclusive. The instructor was Capt. E. W. Barlow. Observers attended from eighteen of the stations and three members of the staff of the Ministry of Agriculture and Fisheries were also present.

After the Thunderstorm: An unexplained Subsidence

IT is not unusual after severe thunderstorms to hear of holes in the ground which are attributed to the heavy rain. Such was the case in the storm at Cannington on the morning of August 19th.

The hole was in a field near Brymore House. It was circular,

about 6 ft. in diameter and 1 ft. to 2 ft. deep. The turf still remained on the sunken ground and the sides were clean cut and not washed. The hole resembled, as much as anything, the falling in of an old well, but no confirmation of this theory could be obtained. The geological formation may have been responsible, soft earth being washed away in the abnormal rain. The surface ground may have collapsed with the extra weight of wet soil as the water drained away. Mr. A. D. Turner, of the Somerset Farm Institute, Cannington, who kindly inspected the hole subsequently, is also of the opinion that it was not caused by any surface agent but was due to a subsidence which occurred after the heavy rain had ceased.

J.G.

The Aeroplane as an Aid to Pilot Balloon Work

THE suggestion was made some time ago that it would be advantageous on occasion to release pilot balloons from aeroplanes instead of from the ground. A balloon which starts from the ground in a strong wind is carried a great distance horizontally before it reaches a considerable height: if the observations could be commenced with the balloon nearly overhead and already 10,000 ft. up, the chance of keeping it in sight up to great altitudes would be greatly increased. The results of preliminary experiments made at the Royal Aircraft Establishment, South Farnborough, have now been reported.

Attempts to release balloons by hand from the cockpits of aeroplanes having met with little success, various devices for carrying a balloon outside a machine's fuselage were tried. Boxes and holding-down tapes proved useless in wind channel experiments: eventually a hemispheric bowl was designed, and this has been used successfully. The 18-in. diameter aluminium bowl used is supported by three tubular steel legs attached to the top of the fuselage aft of the observer's cockpit. It is offset to starboard with its opening facing aft, the plane of its rim being at an angle to the fore and aft line of the machine. This arrangement is adopted to permit the slipstream to carry the balloon to starboard of the tail.

A balloon placed in the bowl is held in position by a shaped canvas cover which is secured by a cord passing round it behind the beaded edge of the bowl's rim. This cord can be released quickly by withdrawing a pin passed through loops in the cord. The cover is permanently attached at one point to prevent its being carried away when released. A large number of small holes drilled in the bowl allow air to pass inwards from the front, which assists the balloon to escape from the bowl when the released cover has been stripped off by the slipstream. Since

the bowl sets up severe stresses in a machine, it is impossible, with the machines available, to fit a bowl large enough to carry a large balloon inflated so as to give it a lift of 500 ft. per minute, especially as the balloon expands as the height increases.

There is no difficulty in picking up the released balloon with a theodolite, provided that the aeroplane is well in the field of view. The simplest method is for the aeroplane to make a pre-arranged signal over the aerodrome and then fly straight up wind for a minute or two before releasing the balloon, thus reducing the angular velocity to a minimum and allowing time for the ground observer to sight on the aeroplane.

Ballon Sonde Ascent over the Sea

A DINES meteorograph was sent up by Commander Garbett from H.M.S. Kellett (Commander E. F. B. Haselfoot, D.S.O., R.N.), in the evening of June 16th last from a position in the English Channel. Two Pirelli balloons, each of 1·4 kg. weight, were employed in tandem. The first, with a free lift of 3·6 kg., acted as the lifter and was attached to the line through the medium of an automatic dropper set to release it from the line at a height of about 5½ km. The second balloon was permanently attached to the line and served to call attention to the instrument after the fall and prevent it being submerged; the free lift of the latter was 0·9 kg., while the total weight lifted, apart from the two balloons, amounted to some 1·8 kg. The Dines meteorograph was attached at about 5 m. below the second balloon and at a further 9 m. below that was fixed a sea anchor.

The ascent proved quite successful, the lifter balloon was set free at the predetermined height while the rest of the apparatus fell into the sea at a point 9 km. north by west of the position of release. It was picked up almost immediately by an Eastbourne boat-owner and the instrument was returned in due course. The lifter balloon was followed by means of glasses, and is thought to have burst at a height of about 12 km. The temperatures and pressures obtained from the record are as follows:—

Height above M.S.L. k.m	Pressure. mb.	Temperature. Abs.
0·0	1014	293
1·0	902	289
2·0	801	283
3·0	709	279
4·0	626	271
5·0	550	264
5·4	520	262

This is the first ballon sonde ascent to be made from the sea

by the British Meteorological Office. It is a branch of the work which could be developed with advantage to meteorological science.

20½ Kilometres Up

Two ballon sonde ascents were made from the meteorological station at the Sealand Aerodrome, near Chester (formerly known as Shotwick), at 7 a.m. on July 14th and 15th last, each of which reached a height of about 20½ kilometres. There has been much difficulty in obtaining good balloons since the war, and this is the greatest height reached in Great Britain for 12 years. The second balloon was followed by Capt. Jackson with a theodolite and seen to burst 75 minutes after the start; it is therefore possible to calculate the mean rate of ascent, 276 metres per minute. The balloon at the start was 1·4 metres in diameter. It may be noted that, if a formula of the type $V=q\ L^{\frac{1}{3}}\ (L+W)^{-\frac{1}{3}}$ be applicable,* a value of q equal to 131 is demanded for a balloon of this size as against 84 for pilot balloons.

The place of fall of the balloon sent up on July 15th was in the same azimuth as the point of bursting and gives a means of determining approximately the ratio between the mean rates of ascent and fall; it is necessary for this purpose to assume the wind to have been the same in each layer during the two periods that the balloon was traversing it, up and down. The approximate computed rate of descent of the instrument and burst balloon was 830 metres per minute, three times the rate of ascent.

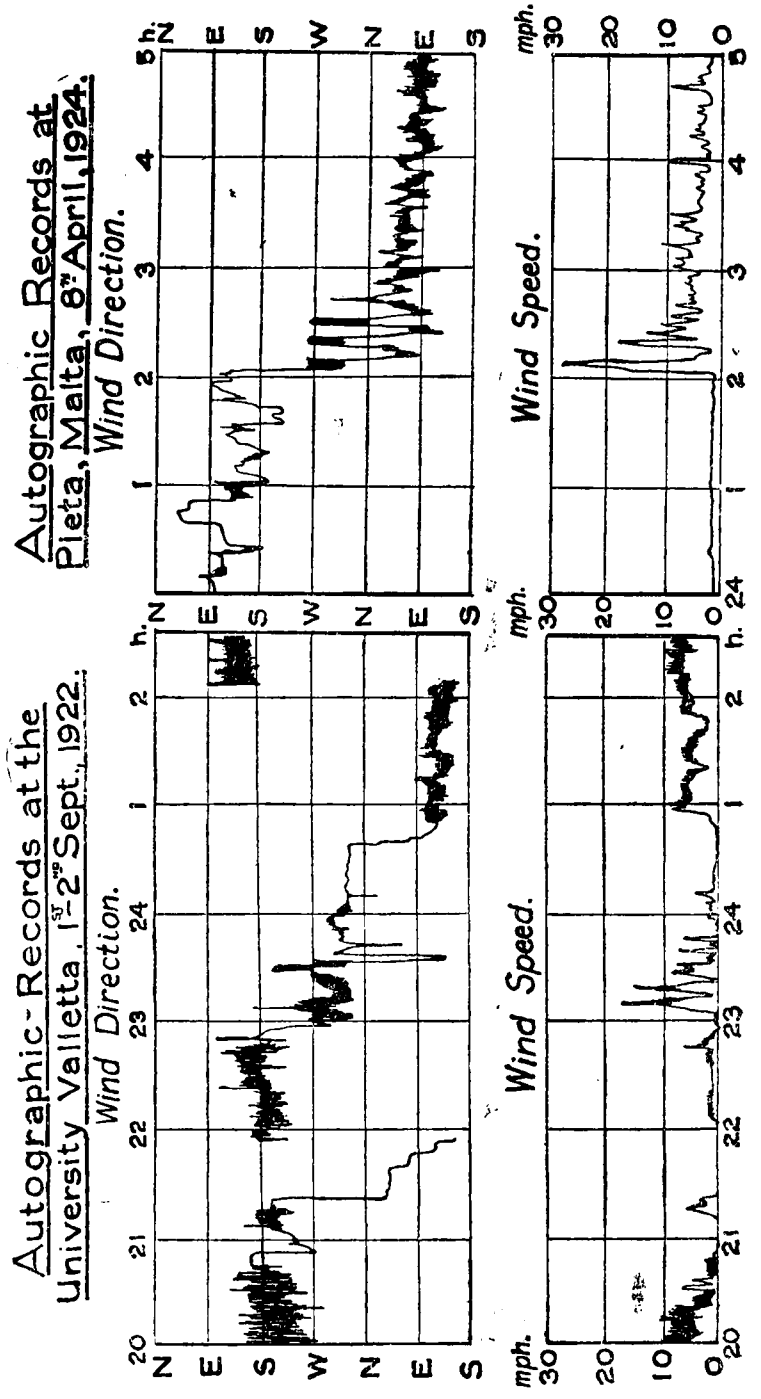
L. H. G. DINES.

A Monthly Bulletin for Brazil

SENOR SAMPAIO FERRAZ, the energetic director of the Brazilian Meteorological Service is an enthusiastic advocate of the prompt circulation of weather reports. Does he not send us a monthly message for publication in the *Meteorological Magazine?* He has now responded to a resolution of the International Meteorological Conference held at Utrecht last September, and commenced the publication of a monthly bulletin. This bulletin is to be issued on the 14th of each month. In addition to the usual meteorological statistics, the bulletin includes an aerological and

* In the formula V=upward velocity in metres per minute, L=the free lift, and W=the weight of the balloon, both in grammes. See the *Meteorological Magazine*, Vol. 55, May, 1920, p. 67.

The latest discussion of the subject of the rate of ascent of balloons is by W. C. Haines in the *Monthly Weather Review*, Vol. 51, May, 1924, p. 249.


Autographic Records at Pieta, Malta, 8th April, 1924.
Wind Direction.
Wind Speed.
Autographic Records at the University Valletta, 1st-2nd Sept., 1922.
Wind Direction.
Wind Speed.
N E S W N E S
mph.
h.

meteoro-agricultural synopsis and a rainfall map covering the more closely populated half of Brazil. The first number gives some particulars of the rainfall at Rio de Janeiro on April 3rd and 4th, 242 mm. (9·53 inches) in 24 hours, the highest amount in such a period, at any rate since 1872.

Sudden Changes of Wind at Malta

THE anemograms reproduced on the opposite page illustrate peculiar changes of wind which occurred at Malta in September, 1922, and April, 1924. In each case there was an interruption of a light surface wind, easterly or southerly, by gusts from the west. A sudden increase of pressure (of the order of 2 mb.) accompanied the onset of the oscillations but there were no appreciable variations in temperature and relative humidity, and therefore there is no evidence of a fresh supply of air at the surface. Both disturbances occurred at night. In the case of the disturbance of September 1st-2nd, 1922, the cloud was mostly alto-cumulus and cumulus. Upper winds at Malta were north-westerly. In the example of April 7th-8th, 1924, the first gusts were westerly and afterwards alternately easterly and northerly, the latter direction changing from north-west to north-east as time went on; but at this stage the gusts were already light and their directions probably have no significance. The first few gusts had velocities diminishing in geometrical progression as in the case of the pressure oscillations described in *Nature* by Professor Duffield.* The weather at this time at Malta was exceptional owing to the prevalence of mist and fog. Stratus and fracto-stratus often obscured the hills which rise to 400 or 600 feet. After the disturbance had passed the surface easterly wind was stronger than previously. Owing to the fog there had been no observations of the upper winds on the previous day.

The distribution of pressure was very similar in the two cases. The western and central Mediterranean was an area of low pressure and slight gradients, which were later replaced by a steep gradient for north-westerly winds. The cooler north-westerly winds reached Malta at the surface thirty-six to forty-eight hours after the occurrences just described. There were also minor disturbances which occurred by day as well as by night.

For permission to use the autographic records of the University Observatory the writer is indebted to the courtesy of Dr. T. Agius.

* *Nature*, London. Vol. cxi., 1923, p. 598.

The Penetrating Radiations of the Upper Air

AT a lecture delivered on June 19th, at University College, London, Professor R. A. Millikan, the distinguished physicist whose experimental work on the sub-atomic structure of matter has been so fruitful, gave a most interesting account of his so far unpublished work recently carried out in America to trace the origin of the so-called " penetrating radiation " which is known to be universally disseminated in nature.

The existence of this radiation, which, as Dr. Simpson has pointed out*, is of considerable interest in atmospheric electricity, was first suspected by H. L. Cooke in 1903, and more fully investigated by V. Hess, after whom the phenomenon was known as Hessian Radiation. From balloon ascents made in June, 1914, Kolhörster found that the number of free ions per cubic centimetre of air in a lead container decreased up to a height of about 1,500 metres, as would be expected in view of the fact that very considerable radio-active emanations are given off from the earth's surface, but that at greater elevations the ionisation increased with height, to the limit reached in the observations (9 kms.). This could only be explained (1) by supposing the ionisation to be due, in part at least, to very hard rays of extra-terrestrial origin, or (2) by assuming the seat of a penetrating radiation to be located in the atmosphere itself. Kolhörster, from the results of his observations, assumed the first alternative. The thickness of the atmosphere, expressed in terms of equivalent absorption by lead is about 80 cms., so that the radiation, if of cosmic origin, would have to be very penetrating, and Kolhörster computed its absorption coefficient as being about 1/10 of that for γ rays.

Prof. Millikan's observations were made during the past year at Mount Whitney, California, and Kelly Fields, Texas. From the latter place, free balloons were sent up carrying a specially designed apparatus weighing only 187 grams, which possessed a photographically recording Wulf electrometer, bimetallic thermometer, barometer (for obtaining the height) and watch for rotating two photographic films—one of which received the electrometer record and the other the barometer and thermometer traces. The results of these ascents may be summarised as follows :—

(1) A height of 17 kms. was reached (*i.e.*, twice that of the Kolhörster observations).

(2) A considerable increase of ionisation at high altitudes was observed ; but

(3) The amount of increase was only about one-quarter of that to be expected from Kolhörster's work—thus showing that his conclusions need revision.

* *Nature*, London, Vol. 99, 1917, p. 123.

During May of this year observations were continued on Mount Whitney, and the coefficient of absorption by lead of the radiation was determined as 0·4, which is almost identical with that for γ rays from Thorium D. From this and the preceding balloon experiments, Prof. Millikan concludes that the so-called penetrating radiation in the upper air, which is manifested inside the vessels used, does not penetrate from outer space, but is of local origin in the atmosphere itself.

In this case, the question as to why radio-active materials are present in larger quantities at 17,000 ft. than at the surface, has still, of course, to be answered. It may possibly be due to some radio-active gas or dust settling in the atmosphere, which may, indeed, even come from the solar protuberances; there is also no reason to suppose that there may not be in the sun itself an unknown element of higher atomic weight than Uranium (>92), which would, of course, be radio-active. Further observations on this difficult problem of meteorology are particularly desirable.

C. V. OCKENDEN.

Reviews

Hints to Meteorological Observers. By the late Wm. Marriott. Eighth edition revised by R. Corless, O.B.E., M.A. 8vo., $9\frac{3}{4} \times 6$, pp. 95, *Illus.* London: Edward Stanford Ltd., 1924. 3s.

William Marriott, the Assistant Secretary of the Royal Meteorological Society from 1872 to 1915, was a keen observer himself, and was in close touch with observers of all classes. The manual which he prepared for the Society, *Hints to Meteorological Observers*, contained just the right amount of information put in just the right way. Since the seventh edition, published in 1911, was exhausted there has been no book which could be regarded as taking its place, for the *Observer's Handbook* of the Meteorological Office is a much heavier work. The Meteorological Society has done well to issue a new edition of the Hints. This edition has been prepared by Mr. R. Corless, one of the Honorary Secretaries of the Society. As Superintendent of the Climatology Division of the Meteorological Office, Mr. Corless can write with authority on the present practice in observing.

The additions which catch the eye are the instructions for estimating visibility and turbulence. In the latter case observations are recommended to the observer who happens to be stationed not far from a tall chimney. By prolonged eye observations or prolonged photography, the shape of the space containing the smoke is obtained, and from measurements of this space and of the time taken by smoke to pass along it, the

" diffusivity " is computed. Perhaps with some experience an observer will be able to simplify the routine and merely mark on a fixed vertical scale the apparent range of the points where the trail cuts the scale. Systematic observations of this sort would be of great interest. As Mr. L. F. Richardson, to whom the instructions are due, points out, the value of the " diffusivity " may vary from ten to a million in centimetre-second units. As to visibility the observer is recommended to work with a series of objects at specified distances and to enter in the register the letter corresponding with the most distant selected object which is visible. A new convention, which turns the difficulty met with where a complete series of objects is not available, is that whilst capitals are used to denote the visibility of actual objects small letters may be used for estimates of intermediate degrees of visibility.

We learn from the preface that " In deference to the practice of the Meteorological Office, instructions for observing barometers graduated in millibars, and for reducing the readings, are included ; as also are instructions for measuring the rainfall in millimetres. The old ' mercury-inch ' pressure unit and the ' inch ' rainfall unit have, however, been retained, as many instruments are still in use which employ those units." It should be mentioned that the same scheme is adopted for the reducing of millibar readings and inch readings of the barometer so that the tables for the two units correspond.

Another change is to be found in the tables provided for the determination of humidity from readings of the dry and wet bulb thermometers. Previously Glaisher's system had been used. Now we find tables based on what are generally known as the moderate wind formulæ, an indication that British meteorologists are coming into line with the general practice abroad wherever humidity is estimated from readings of thermometers in the Stevenson Screen.

The new edition of the Hints will be a useful work of reference for every observer.

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*Anleitung zur Anstellung und Berechnung der Beobachtungen an den Deutschen Meteorologischen Stationen. Ertser Teil.** Edited by G. Lüdeling. Size 11×8, pp. vi.+76+(6). *Illus.* Berlin : Behrend & Co. 1924.

This is the third edition of the first part of the former Prussian *Observer's Handbook.* At the suggestion of Dr. Schmauss, Director of the Bavarian Service, the book has been written to meet the requirements of observers at second and third order stations in the whole of Germany, with the result that a common

* Instructions for arranging and computing observations at the German meteorological stations, Part I.

form of monthly return has now been adopted for the whole of the country. Dr. Lüdeling is responsible for the new edition.

Certain portions of the second part of the Prussian *Anleitung*, notably sections on an aspirator for the wet bulb, the determination of depth of snow, the Campbell-Stokes sunshine recorder and phenological observations have been included in this edition, while a brief section on visibility has been added. It is noticed that the German scale of visibility differs somewhat from that adopted by the International Meteorological Committee.

It is not proposed to issue in the near future a new edition of the second part of the Prussian *Anleitung*, dealing with instruments and observations which do not usually form part of the equipment and programme of a second order station, because many copies of the current edition still remain.

News in Brief

Mr. A. E. Mayers, a clerk in the Shoeburyness Meteorological Office, has been awarded a silver medal in the recent examination in Machine Construction and Design by the National Union of Teachers.

According to the *Times*, M. Jules de Payer is to head a French expedition which will attempt to fly across the north polar regions from Franz Josef Archipelago. M. de Payer expects to leave for the Arctic next month.

The Weather of September, 1924

UNSETTLED weather, with heavy rain at times, prevailed throughout the greater part of the month, although there were fine periods in some districts. From the 2nd to the 6th, fine, sunny conditions were experienced in the northern part of the British Isles, as the anticyclone centred near southern Norway extended also across Scotland ; as much as 13 hours bright sunshine were registered at Crathes (Kincardine) on the 4th, 12·9 hours at Lerwick on the 5th. In the south, the weather was cloudy and rain fell on most days, 31 mm. (1·22 in.) occurred at Norwich on the 4th, but elsewhere the amounts were moderate or slight. On the 6th the conditions changed, a depression approached from the Atlantic and crossed the British Isles from south-west to north-east. This caused general heavy rain on the 6th, 7th and 8th. The heaviest falls occurred on the 7th, when 61 mm. (2·41 in.) fell at Ballynahinch (Galway) ; 57 mm. (2·26 in.) at Aasleagh (Mayo), and 54 mm. (2·13 in.) at Inverness. Thunderstorms occurred in many parts of England between the 7th and the 9th. From the 10th to the 19th depressions were generally centred to the north-west of the British Isles, and south-westerly winds, strong at times, prevailed with frequent heavy rain, but

some bright days *e.g.* the 14th and 18th, when about 11 hours bright sunshine were recorded at several places in England and Scotland. On the 16th, the rainfall was particularly heavy in North Wales and the Lake District, 91 mm. (3·58 in.) being measured at Carnarvon and 75 mm. (2·95 in.) at Dungeon Ghyll. There were also heavy falls in Kerry on the 19th, *e.g.* 63 mm. (2·48 in.) in the Slaheny Valley. After the 19th the depressions developed further south, and high winds or gales occurred at times on parts of our coasts, notably on the night of the 20th to 21st, when a wind of 65 m.p.h. was recorded for two hours at Southport. From the 19th to the 25th bright sunshine and heavy rain continued to alternate. The heaviest falls in this period, which were associated with a depression moving eastwards across the English Channel, occurred in Hampshire on the 25th, when 88 mm. (3·46 in.) were registered at Beaulieu, over 80 mm. (3·15 in.) at Westmeon, Petersfield, and 63 mm. (2·48 in.) at Titchfield. In the rear of this disturbance an anticyclone moved across England, giving fair weather for a day or two, though a fresh depression centred near Iceland caused heavy rain in Ireland and Scotland on the evening of the 28th, and a subsequent renewal of wet weather in England. Day temperatures throughout the month were moderate, 73° F. being the highest reading recorded, but in the earlier parts of the month the nights were warm. The total rainfall for the month was more than double the average in many parts of England and Ireland, and nearly three times the average at Birr Castle and Waterford (see p. 227). Mr. Shaw, the observer at Salcombe, Devon, writes to say that the total rainfall for the 9 months, January to September, 1924, is 817 mm. (32·16 in.), 273 mm. (10·73 in.) above the average.

Pressure being on the average below normal over the whole of western Europe and the eastern North Atlantic except between the Azores and Spain (the deficit exceeded ·5 mb. over most of the area, including the British Isles, and reached 10 mb. at Stornoway), the weather in the north-west and west of Europe was generally unsettled, with mainly south-westerly winds, much rain and many gales, while the mean temperature was a few degrees above normal. In Switzerland the temperature was normal and the rainfall local, heavy rains having caused a landslide, which swept away Someo, a village in the Canton of Ticino, while at Zurich the fall was less than usual. In France and parts of Switzerland the continued wet weather was responsible for the ruin of the wheat crop, and a very poor yield of flour is anticipated. In the Mediterranean the weather was more favourable, and very warm weather prevailed during the first fortnight, Malta reaching a maximum of 102° F. on the 10th. (The previous September record, 1853 to 1923, was 100° F.)

Among the phenomena of the month we note a heavy storm which swept over Denmark on the 11th, damaging the fruit crops and driving several ships ashore, and serious floods in Leningrad on the 23rd.*

The rainfall in India for the week ending the 24th, was reported to be scanty in the Bay Islands, Lower Burma, Central India (East), and North-west India. It was excessive in the Peninsula where the monsoon was still strong. During the last week of the month heavy rain fell in the Punjab between Delhi and Kumaon. At Mussooree 15 in. of rain were recorded in two days, and at Naim Tal 18 in. in 3 days. In the surburbs of Delhi and in parts of the Punjab over 40 villages were submerged, and many more flooded. The Ramganga, a tributary of the Ganges, rose to an unprecedented height and serious breaches have been made in the railways.

On September 7th great damage was caused by a typhoon in the port of Taihoku, Formosa. The casualties numbered over 300, 60 craft in the port were sunk, and over 100 bridges destroyed

At the end of the month there were extensive floods in the Eastern United States, and a storm on the 30th caused much damage. Many rivers were in flood, and Oneida Creek, New York, which usually has a width of 50 ft., was half a mile wide. There was a gale in New York City and an inch of rain fell. The weather was so bad that the liner Olympic had great difficulty in entering the harbour. Floods are also reported from Quebec, where the municipality of Baie St. Paul is threatened unless the water soon subsides. A fishing schooner was wrecked in a hurricane on the 4th off Newfoundland on the St. Pierre Archipelago and 24 lives were lost.

The Oxford University Arctic Expedition, recently returned to England after exploring Spitsbergen, reports that this season has been the worst for 15 years, owing to northerly gales, blizzards and sea ice.

The special message from Brazil, states that the rainfall was generally scanty, being 40 mm., 27 mm. and 59 mm. below normal in the northern, central and southern districts respectively. The crops in the southern and central districts have been badly affected by the scarcity of rain during the critical periods. The general circulation was less active than in the previous month. At Rio de Janeiro pressure was 2·5 mb. above normal and temperature ·5° F. below normal.

Rainfall September, 1924: General Distribution

England and Wales	174	per cent of the average 1881-1915.
Scotland	173	
Ireland	217	
British Isles	183	

* The newspaper reports refer to a "tidal wave." There were strong west winds up the Gulf of Finland; we have no information as to whether the Neva was in flood above Leningrad.

Rainfall: September, 1924: England and Wales.

CO.	STATION.	In.	mm.	Per-cent. of Av	CO.	STATION.	In.	mm.	Per-cent. of Av.
Lond.	Camden Square.....	2·59	66	142	*War.*	Birminghm, Edgbaston	3·53	90	197
Sur .	Reigate, Hartswood...	3·39	86	174	*Leics*	Leicester Town Hall...	2·41	61	...
Kent.	Tenterden, View Tower	1·83	47	86	,, .	Belvoir Castle.....	2·73	69	146
,, .	Folkestone, Boro. San.	2·67	68	...	*Rut .*	Ridlington.....	2·64	67	...
,, .	Broadstairs	1·59	40	...	*Linc.*	Boston, Skirbeck	2·12	54	120
,, .	Sevenoaks, Speldhurst.	3·72	95	...	,, .	Lincoln, Sessions House	2·11	54	137
Sus .	Patching Farm.....	3·57	91	149	,, .	Skegness, Estate Office.	2·18	55	120
,, .	Eastbourne, Wilm. Sq.	2·44	62	98	,, .	Louth, Westgate	3·03	77	150
,, .	Tottingworth Park....	3·61	92	147	,, .	Brigg	2·36	60	140
Hants	Totland Bay, Aston...	4·65	118	209	*Notts.*	Worksop, Hodsock....	2·62	67	172
,, .	Fordingbridge, Oaklnds	4·53	115	211	*Derby*	Mickleover, Clyde Ho..	3·09	79	173
,, .	Portsmouth, Vic. Park.	5·73	145	264	,, .	Buxton, Devon. Hos...	5·29	134	163
,, .	Ovington Rectory	6·05	154	264	*Ches.*	Runcorn, Weston Pt...	3·96	101	148
,, .	Grayshott	5·85	148	242	,, ..	Nantwich, Dorfold Hall	3·51	89	...
Berks	Wellington College...	3·40	86	185	*Lancs*	Bolton, Queen's Park .	4·67	119	...
,, .	Newbury, Greenham..	4·63	118	229	,, ..	Stonyhurst College....	4·99	127	131
Herts.	Bennington House....	...	..	...	,, ..	Southport, Hesketh...	4·72	120	172
Bucks	High Wycombe	3·76	95	199	,, ..	Lancaster, Strathspey.	5·18	132	...
Oxf..	Oxford, Mag. College..	4·06	103	242	*Yorks*	Sedbergh, Akay	7·19	183	171
Nor .	Pitsford, Sedgebrook..	3·19	81	177	,, .	Wath-upon-Dearne ...	2·65	67	168
,, .	Eye, Northolm.....	1·94	49	...	,, .	Bradford, Lister Pk...	3·46	88	167
Beds.	Woburn, Crawley Mill.	3·17	80	166	,, .	Oughtershaw Hall	8·39	213	...
Cam.	Cambridge, Bot. Gdns.	2·08	53	129	,, .	Wetherby, Ribston H..	3·44	87	191
Essex	Chelmsford, CountyLab	2·39	61	...	,, .	Hull, Pearson Park ...	2·27	58	132
,, .	Lexden, Hill House...	1·66	42	...	,, .	Holme-on-Spalding ...	2·34	59	...
Suff .	Hawkedon Rectory ...	3·19	81	165	,, .	Lowthorpe, The Elms.	2·48	63	143
,, .	Haughley House.....	2·42	61	...	,, .	West Witton, Ivy Ho..	3·18	81	...
Norf.	Beccles, Geldeston....	3·39	86	176	,, .	Pickering, Hungate ...	2·20	56	...
,, .	Norwich, Eaton	...	...	...	,, .	Middlesbrough	1·83	47	110
,, .	Blakeney	2·42	61	130	,, .	Baldersdale, Hury Res.	3·91	99	143
,, .	Swaffham	2·62	67	123	*Durh.*	Ushaw College	3·46	88	172
Wilts.	Devizes, Highclere....	3·56	90	175	*Nor .*	Newcastle, Town Moor.	2·73	69	134
Dor .	Evershot, Melbury Ho.	5·19	132	195	,, .	Bellingham Manor....	3·30	84	...
,, .	Weymouth, Westham..	3·23	82	154	,, .	Lilburn Tower Gdns...	3·14	80	...
,, .	Shaftesbury, Abbey Ho.	3·10	79	128	*Cumb*	Penrith, Newton Rigg..	...	...	...
Devon	Plymouth, The Hoe...	3·88	99	158	,, .	Carlisle, Scaleby Hall .	3·42	87	127
,, .	Polapit Tamar	4·09	104	146	,, .	Seathwaite	16·25	413	164
,, .	Ashburton, Druid Ho..	7·09	180	228	*Glam.*	Cardiff, Ely P. Stn.....	6·74	171	217
,, .	Cullompton	5·61	142	249	,, .	Treherbert, Tynywaun	13·79	350	...
,, .	Sidmouth, Sidmount ..	5·55	141	241	*Carm*	Carmarthen Friary....	7·97	202	230
,, .	Filleigh, Castle Hill ...	6·47	164	...	,, .	Llanwrda, Dolaucothy.	8·99	228	221
,, .	Hartland Abbey.....	4·36	111	...	*Pemb*	Haverfordwest, Portf'd	5·35	136	...
Corn.	Redruth, Trewirgie ...	4·44	113	142	*Card.*	Gogerddan.....	7·24	184	199
,, .	Penzance, Morrab Gdn.	3·57	100	122	,, .	Cardigan, County Sch. .	5·41	137	...
,, .	St. Austell, Trevarna..	4·16	106	130	*Brec .*	Crickhowell, Talymaes	8·00	203	...
Soms	Chewton Mendip	4·36	111	142	*Rad .*	Birm. W. W. Tyrmynydd	8·32	211	216
,, .	Street, Hind Hayes ...	3·49	89	...	*Mont.*	Lake Vyrnwy	...	...	...
Glos..	Clifton College	3·82	97	162	*Denb.*	Llangynhafal	5·13	130	...
,, .	Cirencester	4·29	109	190	*Mer .*	Dolgelly, Bryntirion..	8·37	213	197
Here.	Ross, County Obsy. ...	5·08	129	251	*Carn.*	Llandudno	3·52	89	154
,, .	Ledbury, Underdown.	5·10	129	267	,, .	Snowdon, L. Llydaw 9	20·15	512	...
Salop	Church Stretton.....	4·32	110	213	*Ang .*	Holyhead, Salt Island.	6·21	157	232
,, .	Shifnal, Hatton Grange	3·15	80	163	,, .	Lligwy	5·94	151	...
Staff.	Tean, The Heath Ho...	3·51	89	147	*Isle of Man*				
Worc.	Ombersley, Holt Lock.	...	...	...		Douglas, Boro' Cem...	6·53	166	198
,, .	Blockley, Upton Wold.	4·98	127	237	*Guernsey*				
War.	Farnborough.....	4·42	112	208		St. Peter Port Grange.	4·90	124	188

Rainfall: September, 1924: Scotland and Ireland

CO.	STATION	In.	mm.	Per-cent. of Av.	CO.	STATION.	In.	mm.	Per-cent. of Av.
Wigt.	Stoneykirk, Ardwell Ho	5·86	149	210	*Suth.*	Loch More, Achfary...	8·58	218	149
,, .	Pt. William, Monreith .	6·07	154	...	*Caith*	Wick	4·07	103	163
Kirk.	Carsphairn, Shiel.	10·68	271	...	*Ork .*	Pomona, Deerness	5·03	128	173
,, .	Dumfries, Cargen.....	5·80	147	197	*Shet .*	Lerwick	4·08	103	136
Dum	Drumlanrig	5·58	142	189					
Roxb	Branxholme	4·29	109	192	*Cork.*	Caheragh Rectory	8·62	219	...
Selk .	Ettrick Manse.....	5·69	144	...	,, ..	Dunmanway Rectory.	8·08	205	197
Berk.	Marchmont House	3·73	95	155	,, ..	Ballinacurra	5·45	138	216
Hadd	North Berwick Res....	4·07	103	195	,, ..	Glanmire, Lota Lo. ...	6·56	167	234
Midl	Edinburgh, Roy. Obs..	2·81	71	154	*Kerry*	Valencia Obsy.	...	...	...
Lan .	Biggar	3·87	98	170	,, .	Gearahameen	10·30	262	...
Ayr .	Kilmarnock, Agric. C..	5·33	135	174	,, .	Killarney Asylum.....	7·32	186	204
,, .	Girvan, Pinmore.....	6·88	175	180	,, .	Darrynane Abbey	8·67	220	244
Renf.	Glasgow, Queen's Pk..	4·51	115	163	*Wat .*	Waterford, Brook Lo..	8·12	206	293
,, .	Greenock, Prospect H..	7·41	188	156	*Tip .*	Nenagh, Cas. Lough...	7·55	192	269
Bute.	Rothesay, Ardencraig.	5·66	144	140	,, .	Tipperary	5·26	134	...
,, .	Dougarie Lodge	6·55	166	...	,, .	Cashel, Ballinamona ..	5·41	137	221
Arg .	Glen Etive.....	12·91	328	...	*Lim .*	Foynes, Coolnanes	5·31	135	190
,, .	Oban	7·44	189	...	,, .	Castleconnell Rec.	7·03	179	...
,, .	Poltalloch	5·97	152	131	*Clare*	Inagh, Mount Callan ..	8·27	210	...
,, .	Inveraray Castle.....	9·27	235	144	,, .	Broadford, Hurdlest'n.	8·36	212	...
,, .	Islay, Eallabus.....	6·56	167	157	*Wexf*	Newtownbarry.....	7·34	186	...
,, .	Mull, Benmore	9·60	244	...	,, .	Gorey, Courtown Ho...	6·08	154	246
Kinr.	Loch Leven Sluice	4·08	104	159	*Kilk.*	Kilkenny Castle	5·75	146	249
Perth	Loch Dhu	9·05	230	158	*Wic .*	Rathnew, Clonmannon	5·63	143	...
,, ..	Balquhidder, Stronvar.	...	...	...	*Carl .*	Hacketstown Rectory .	6·39	162	228
,, ..	Crieff, Strathearn Hyd.	4·99	125	171	*QCo..*	Blandsfort House.....	5·71	145	210
,, ..	Blair Castle Gardens ..	4·72	120	...	,,	Mountmellick	7·37	187	...
,, .	Coupar Angus School..	3·24	80	163	*KCo.*	Birr Castle.....	6·76	171	295
Forf.	Dundee, E. Necropolis.	4·53	115	218	*Dubl.*	Dublin, FitzWm. Sq...	4·94	125	257
,, .	Pearsie House.....	5·27	134	...	,, .	Balbriggan, Ardgillan .	5·88	149	288
,, .	Montrose, Sunnyside..	4·48	114	225	*Me'th*	Drogheda, Mornington	5·48	139	...
Aber.	Braemar Bank	4·75	121	189	*W.M*	Mullingar, Belvedere .	6·01	153	225
,, .	Logie Coldstone Sch. ..	4·04	103	173	*Long*	Castle Forbes Gdns....	4·97	126	173
,, .	Aberdeen, Cranford Ho	4·96	126	212	*Gal .*	Galway, Waterdale ...	...	...	...
,, .	Fyvie Castle	4·65	118	...	,, .	Ballynahinch Castle ..	9·19	233	...
Mor .	Gordon Castle.....	4·58	116	183	*Mayo*	Mallaranny.....	6·85	174	...
,,	Grantown-on-Spey....	3·99	101	161	,, .	Westport House.....	5·01	127	141
Na .	Nairn, Delnies.....	3·89	99	177	,, .	Delphi Lodge	13·15	334	...
Inv..	Ben Alder Lodge	9·38	238	...	*Sligo*	Markree Obsy.	6·10	155	180
,, .	Kingussie, The Birches	4·09	104	...	*Ferm*	Enniskillen, Portora ..	5·27	134	...
,, .	Fort Augustus	...	...	...	*Arm.*	Armagh Obsy.	5·25	133	213
,, .	Loch Quoich, Loan....	16·40	417	...	*Down*	Warrenpoint	5·61	143	...
,, .	Glenquoich	14·39	365	166	,, .	Seaforde	7·63	194	277
,, .	Inverness, Culduthel R.	4·75	121	...	,, .	Donaghadee	...	...	...
,, .	Arisaig, Faire-na-Squir	7·58	193	...	,, .	Banbridge, Milltown .	5·37	136	137
,, .	Fort William.....	8·98	228	143	*Antr.*	Belfast, Cavehill Rd. ..	5·99	152	...
,, .	Skye, Dunvegan.....	6·60	168	...	,, .	Glenarm Castle.....	6·59	167	...
,, .	Barra, Castlebay	2·10	53	...	,, .	Ballymena, Harryville	5·64	143	181
R&C	Alness, Ardross Cas. ..	6·20	157	212	*Lon .*	Londonderry, Creggan	6·03	153	183
,, .	Ullapool.....	5·48	139	...	*Tyr .*	Donaghmore	6·27	159	...
,, .	Torridon, Bendamph..	11·35	288	163	,, .	Omagh, Edenfel	5·48	139	180
,, .	L. Carron, Plockton...	5·64	143	...	*Don .*	Malin Head	5·14	130	196
,, .	Stornoway	5·25	133	133	,, .	Rathmullen.....	5·12	130	...
Suth.	Lairg	4·44	113	...	,, .	Dunfanaghy	6·43	163	186
,, .	Tongue Manse.....	6·32	161	200	,, .	Narin, Kiltoorish	5·97	152	...
,, .	Melvich School.....	5·80	147	207	,, .	Killybegs, Rockmount.	8·24	209	179

Climatological Table for the British Empire, April, 1924

STATIONS	PRESSURE		TEMPERATURE							Relative Humidity	Mean Cloud Am'nt	PRECIPITATION			BRIGHT SUNSHINE	
			Absolute		Mean Values				Mean							
	Mean of Day M.S.L.	Diff. from Normal	Max.	Min.	Max.	Min.	½ max. and min.	Diff. from Normal	Wet Bulb.			Am'nt	Diff. from Normal	Days	Hours per day	Percentage of possible.
	mb.	mb.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	%	0—10	mm.	mm.			
London, Kew Obsy.	1012·4	− 2·0	71	29	54·0	39·6	46·8	− 0·5	44·3	77	6·9	86	+ 49	15	4·1	30
Gibraltar	1016·3	− 0·2	78	47	67·8	54·5	61·1	+ 0·1	55·4	72	4·7	79	+ 11	7	...	...
Malta	1014·8	+ 2·3	79	49	66·4	55·9	61·1	+ 1·4	56·0	78	4·2	53	+ 33	3	9·5	73
Sierra Leone	1010·4	− 0·6	93	71	90·3	75·8	83·1	+ 0·3	77·5	73	5·1	69	− 34	8	...	...
Lagos, Nigeria	1007·9	− 1·9	92	72	89·7	78·3	84·0	+ 1·7	80·3	77	5·0	192	+ 43	12	...	...
Kaduna, Nigeria	1011·0	+ 0 3	99	...	93·7	...	...	...	72·5	61	0·9	41	− 27	6	...	...
Zomba, Nyasaland	1013·6	+ 1·7	82	54	76·3	58·8	67·5	− 1·8	...	89	6·1	14	− 91	6	...	...
Salisbury, Rhodesia	1013·7	− 0·7	85	44	77·3	50·4	63·9	− 2·0	56·0	56	1·6	0	− 26	0	...	...
Cape Town	1017·2	+ 0·9	94	47	74·8	55·8	65·3	+ 2·2	59·1	62	3·4	22	− 29	3	...	...
Johannesburg	1018·2	+ 1·6	75	41	69·5	49·6	59·5	− 0·1	51·1	64	1·6	27	− 25	6	8·4	74
Mauritius	1011·8	− 2·2	85	61	81·3	70·5	75·9	+ 0·1	71·2	79	5·5	79	− 35	12	7·0	61
Bloemfontein	...	...	80	39	73·0	46·0	59·5	− 1·3	52·3	69	1·4	26	− 28	5	...	...
Calcutta, Alipore Obsy.	1005·4	− 0·9	105	73	99·4	78·6	89·0	+ 3·3	78·2	76	3·5	8	− 36	1*	...	...
Bombay	1007·6	− 1·0	94	76	91·3	79·3	85·3	+ 2·2	76·4	70	2·4	0	− 2	0*	...	...
Madras	1007·3	− 1·1	99	75	94·5	79·1	86·8	+ 1·5	79·0	68	3·8	0	− 15	0*	...	...
Colombo, Ceylon	1008·3	− 0·8	92	71	88·9	76·3	82·6	− 0·1	79·4	70	6·2	227	− 25	20	8·5	69
Hong Kong	1011·5	− 1·1	85	57	74·4	65·8	70·1	− 0·8	66·3	85	8·5	158	+ 18	13	3·4	27
Sandakan	...	...	91	75	88·4	77·0	82·7	+ 0·5	77·4	78	...	102	− 4	6	...	...
Sydney	1016·0	− 2·4	82	49	71·3	56·4	63·9	− 0·7	58·1	68	4·6	180	+ 42	15	6·2	55
Melbourne	1019·2	− 0·2	81	43	63·4	49·9	56·7	− 2·8	53·1	72	6·7	93	+ 36	13	4·1	37
Adelaide	1022·0	+ 2·2	84	45	68·2	50·8	59·5	− 4·3	53·6	64	5·9	37	− 9	14	4·8	43
Perth, W. Australia	1019·6	+ 1·2	91	48	80·5	59·3	69·9	+ 3·5	59·8	52	4·7	8	− 33	2	6·5	58
Coolgardie	1022·9	+ 4·4	94	45	77·5	52·8	65·1	0·0	56·1	42	3·7	11	− 13	1	...	...
Brisbane	1015·7	− 1·7	88	50	78·4	60·7	69·5	− 0·9	64·2	64	4·6	68	− 23	4	6·9	61
Hobart, Tasmania	1013·1	− 1·4	71	39	54·1	47·7	50·9	− 4·2	50·2	70	6·1	63	+ 15	17	5·5	50
Wellington, N.Z.	1018·1	+ 0·3	78	43	68·4	56·3	62·3	+ 5·5	57·9	75	6·9	69	− 30	8	4·3	39
Suva, Fiji	1010·8	+ 0·2	89	64	85·1	72·1	78·6	− 0·1	75·2	81	6·1	277	− 10	19	...	...
Kingston, Jamaica	1013·7	− 0·4	92	67	89·4	69·9	79·7	+ 1·3	72·5	63	3·2	21	− 10	2	...	...
Grenada, W.I.	1013·3	+ 0·7	87	71	85·4	74·0	79·7	+ 0·9	73·9	70	3·8	10	− 50	7	...	...
Toronto	1014·7	− 0·8	66	19	51·0	34·6	42·8	+ 1·4	37·8	72	5·1	65	+ 4	11	6·8	51
Winnipeg	1012·6	− 4·4	65	8	43·6	28·1	35·9	− 1·9	34·5	92	6·9	89	+ 51	16	4·0	29
St. John, N.B.	1013·6	0·0	56	23	43·3	30·2	36·7	− 2·3	33·7	82	7·0	82	− 7	13	3·4	25
Victoria, B.C.	1020·8	+ 3·5	70	34	53·8	41·2	47·5	− 0·2	42·4	75	6·0	46	+ 2	10	6·6	48

* For Indian stations a rain day is a day on which 0·1 in. (2·5 mm.) or more rain has fallen.

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The International Union of Geodesy and Geophysics

MEETING IN MADRID, OCTOBER 1924

THE International Union of Geodesy and Geophysics held its second meeting in Madrid from October 1st to 8th, 25 out of the 27 countries which have adhered to the Union being represented. The arrangements made by the Spanish Committee for the comfort and entertainment of the delegates were on a most lavish scale, and all who attended carried away with them most grateful recollections of Spanish courtesy and hospitality. His Majesty the King of Spain presided in person at the opening meeting, and on the evening of Saturday, October 4th, the delegates had the honour of being received at the Palace, and of being individually presented to Their Majesties. Opportunities were provided for seeing not only the scientific institutions, but also the artistic treasures of Madrid under expert guidance. Excursions to places of interest, such as Toledo and Escorial, formed part of the official programme, while for those who could afford the time, there were organised excursions after the meeting to southern Spain. Limitations of space, however, make it impossible to give an account of all that was done to render the meeting the great success it was from the social point of view.

The sessions of the Union were held in the Parliament buildings, the plenary meetings taking place in the hall where the Cortes deliberate, while the sectional meetings were held in the adjoining

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committee rooms. The meteorological section had a very full programme and it needed all the organising ability and experience of the President, Sir Napier Shaw, to dispose of the necessary business in the time available. In arranging the work it was necessary to stress two principles. Firstly, that the Union exists for the furtherance of geophysical studies, and that consequently questions dealing with the applications of meteorology to economic problems are outside its scope, and are better left to the other international organisation, represented by the International Meteorological Committee which is now, under the new constitution adopted at Utrecht in 1923, confined to the Directors of Meteorological Services. Secondly, that, in order to avoid overlapping, the section should direct its attention more particularly to problems which lie outside the normal activities of the state services. Perhaps we might also add that the section should not be regarded as an appropriate place for reading and discussing papers of general meteorological interest. It should confine its attention to problems which require international co-operation for their further development.

Unlike the Meteorological Committee, the International Union has at its disposal certain funds derived from the subscriptions of the Governments which have adhered to the Union, and the business of the sections is thus to a large extent devoted to making arrangements for using this money to the best advantage. The meteorological section may look forward to having at its disposal during the next three years a sum of approximately £1,800, on which printing and secretarial expenses will form a first charge. An account of the work of the section thus becomes in the main an account of the arrangements approved for the allocation of this money.

One of the first subjects to be considered was that of solar radiation. Much of the recent work in this field has aimed at the measurement of the so-called solar constant, in other words at determining the amount of energy that reaches the outer limits of our atmosphere from the sun. With this object in view, the solar physicist has placed his observatories on mountain tops, preferably in regions where there is normally little cloud, in order to avoid as far as possible the absorption in the atmosphere. To the meteorologist, however, it is precisely this absorption that is a matter of special interest, and observations of the amount of energy received per unit area near sea level in different parts of the world are of primary importance. At the last meeting of the section, held in Rome in 1922, the officers were accordingly requested to prepare a report on such observations. By way of discharging this obligation, Sir Napier exhibited at Madrid a large map of the world showing the positions of the observatories for which such observations were available, with insets

summarising the results. Needless to say the map shows many gaps which cry aloud to be filled. Professor Gorzinski, bringing to the notice of the section some recent work of his own, also urged the section to take steps to remedy the defect. It was therefore decided to follow a precedent set at Rome in connection with work on dust in the atmosphere, and to set aside a sum for the purchase of instruments for use in regions where observations appeared to be specially needed, provided that the responsible authorities are prepared to accept them and make arrangements for their use. A small commission was appointed to make the necessary arrangements.

The same commission was also authorised to endeavour to arrange for observations to be made in different countries with an instrument submitted to the section by Mr. L. F. Richardson, which enables a photometric comparison to be made in æroplanes between the radiation received from sun and sky and that reflected from the earth's surface. A sum of £400 was allocated under these heads.

In connection with the observation of dust in the atmosphere, satisfactory reports were received of observations made with the dust counters distributed by the section after the Rome meeting. A small commission was appointed to watch over the continuance of this work, but it was considered that, now that observations had been inaugurated in various parts of the world, the section need not allocate further funds to the matter.

The investigation of the upper air naturally occupied a prominent place on the agenda. Here, again, there is crying need for observations in regions for which none of the national services accept special responsibility, conspicuous among which are the oceans, the polar regions, and the desert areas of the globe. The programme inaugurated at Rome was therefore re-affirmed, and the balance (approximately £250) of the sum set aside for the provision of instruments, for use in such regions as opportunities may offer, was again placed at the disposal of the officers for this purpose. Another aspect of upper air work that calls for international co-operation, is that of the publication of the observations. Before the war the observations were published internationally, but the old organisation has ceased to work, and up to the present has not been replaced despite the fact that the question has been discussed. By way of getting a move on, a sum of £500 was allocated to the President in his capacity as President of the International Commission for the Study of the Upper Air in aid of the publication of a year's results of observations as a specimen. The total sum allocated to upper air work was £750.

There was, further, a number of subjects on the agenda which the President had grouped together, as they all appeared to imply

the existence of an international meteorological bureau for their solution. The President suggested that the section might bring this difficult question a step nearer solution by selecting one of the subjects for investigation and inviting some individual to report on it, making him a grant to defray charges for clerical or technical assistance. If the work were successfully accomplished, the precedent once set might be followed in other directions, and so gradually the much desired bureau might come into existence. The principle found ready acceptance, but considerable differences of opinion arose over the subject to be selected for the experiment. Sir Napier suggested that the problem submitted by the British National Committee, the comparison of the weather on (magnetic) quiet and disturbed days, would form a very suitable subject, but the preparation of authoritative charts of the Northern Hemisphere on the lines of the charts of the North Atlantic formerly published jointly by the Danish Institute and the Deutsche Seewarte also found many supporters.

When the question finally came to be voted upon, the majority of votes were cast in favour of the latter proposal. A sum of £500 was accordingly allocated to the publication, by way of an experiment, of daily synoptic charts of the Northern Hemisphere for the three months, July, August, and September, 1923. The work was entrusted to M. La Cour, the Director of the Danish Meteorological Service, acting in consultation with a commission consisting of those members of the Commission for Charts of the North Atlantic, appointed by the International Meteorological Committee, who belong to states which have adhered to the Union. Thus, the newly created International Union has turned again to one of the oldest fields of international co-operation in its first attempt to give tentative effect to the idea of an international bureau.

It remains to mention the arrangements made for filling the office of President of the section. The rules of the Union contemplate that the presidents of sections shall hold office over two meetings and then retire. Sir Napier Shaw had presided at Rome in 1922, as well as at Madrid, and thus his term of office should have terminated. At the last meeting of the section, M. Lallemand, the President of the Union, asked to be heard, and in a few well chosen words, in which he dwelt on Sir Napier's services to meteorology and on his unrivalled experience of the conduct of international meteorological meetings, invited the section to depart from the accepted practice, and to endeavour to persuade Sir Napier to accept office for a further period. Sir Napier having expressed his willingness to serve again, the proposal was carried by acclamation.

R. G. K. LEMPFERT,

Discussions at the Meteorological Office

October 13th, 1924. *Light emitted from solid Nitrogen when bombarded with Cathode Rays and its bearing on the Auroral Spectrum.* By L. Vegard. (Amsterdam Proc. K. Akad. Wet. Vol. XXVI., p. 113), and *On the Luminescence of Nitrogen, Argon and other condensed Gases at very low Temperatures.* By J. C. McLennan and G. M. Shrum (London Proc. R. Soc., Vol. 106 A, 1924, p. 138). *Opener*—Dr. G. C. Simpson, F.R.S.

The first of the papers set down for discussion on this occasion has already been referred to in the *Meteorological Magazine.* It will be recalled that Professor Vegard having found that many of the lines of the auroral spectrum could be identified with those of nitrogen and that these lines as well as the characteristic green line persisted from the top to the bottom of the rays perhaps from 300 to 60 miles above the ground, put forward the theory that nitrogen must be the main constituent of the atmosphere at these great heights. He suggested that the nitrogen formed aggregates like minute solid crystals and that electric forces prevented it from sinking. To test his theory he experimented in the laboratory of Professor Onnes at Leyden, and was overjoyed to find that solid nitrogen when bombarded by an electric discharge gave a green glow and that, as nearly as he could tell with the spectroscopes he was using, the wave-length of the principal line in the spectrum of the glow was identical with that of the green line of the aurora.

The next chapter in the story is to be found in the paper by McLennan and Shrum. These authors have been working in the low-temperature laboratory at Toronto equipped by Professor McLennan on the Leyden model, and have studied the spectrum of nitrogen at low temperatures with the aid of a spectroscope with high dispersion. They have been able to determine the wave-lengths with great accuracy. They find that if nitrogen vapour at low temperatures is irradiated by electrons it becomes luminescent and the spectrum of the emitted light includes three wave-lengths in the yellow-green region, the wave-lengths being 5556, 5617 and 5654 Ångstrom units respectively. Solid nitrogen phosphorescing at the temperature of liquid hydrogen gives light of a single wave-length, 5231 units.

The precision of these results is in sharp contrast to the figures given by Vegard, whose measurements had shown that when his solid nitrogen was being bombarded the principal band in the spectrum lay between 5522 and 5689 Ångstrom units. Vegard appears to have been too optimistic in averaging readings covering such a wide range and giving out that this average

represented the true wave-length. Now the wave-length of the characteristic auroral line is known with extraordinary accuracy. H. D. Babcock* using an interferometer and exposing it to the night sky for many hours found this wave-length to be 5577·35 Ångstrom units. This wave-length is not one of those occurring in McLennan and Shrum's observations, and no evidence is left for the identification of solid nitrogen as the origin of the auroral light. Whilst meteorologists must feel some regret that the chain of Vegard's argument has been broken so soon, they are perhaps relieved to know that they have not to provide an explanation for temperatures below the freezing point of nitrogen in the upper atmosphere.†

In this connection Dr. Simpson pointed out that interferometer photographs give us a very limited choice of elements for generating the auroral light. Babcock found that the width of the individual rings in the photographs indicated that the range of wave-length in the green auroral light was about ·035 Ångstrom unit. Now, in laboratory experiments on a gas producing monochromatic light the range of wave-length is found to depend on the temperature of the gas and the mass of the atoms.‡ The explanation is based on the Doppler effect. If a number of locomotives had their whistles tuned to unison and if these whistles were blown together whilst the locomotives were travelling at various speeds a listener would find the noise discordant because some of the whistles would be raised in pitch and some lowered. Similarly if gas molecules are all giving out light with the same frequency there will be a certain range of wave-length in the light which reaches an observer. Accordingly the average speed of the molecules of the gas from which the auroral light comes, can be estimated. The light might come from hydrogen at 55° A, (—360° F.) helium at 220° A. (—95° F.) or from a heavier element at a higher temperature. Nitrogen would have to be at 800° A, oxygen at 900° A. This evidence as far as it goes suggests that helium is the wanted element in spite of the fact that the appropriate means of producing the light from it in the laboratory have not been evolved. However that may be, Vegard's part in the story of the aurora will not be forgotten.

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* *Astroph. J. Chicago, Ill. Vol.* 57, 1923, *p.* 209.

† The physical objections to the theory are set out in a recent paper by R. d'E. Atkinson, of Hertford College, Oxford. Atkinson favours oxygen as the most likely source of the green auroral light. *London, Proc. R. Soc. Vol.* 106 *A.* 1924, *p.* 249.

‡ The moving particles which are stimulated to emit light are atoms not molecules. *Buisson et Fabry, J. Phys., Paris. Ser.* 5. *Vol.* 2, 1912, *p.* 455.

October 27th, 1924. *Measurements of the Sun's Ultra-Violet Radiation and its absorption by the Earth's atmosphere.* By G. M. B. Dobson (London. Proc. R. Soc. Vol. 104 A. 1923, p. 252). *Opener*—Captain F. Entwistle, B.Sc.

In this paper Mr. Dobson has developed a method of recording photographically the part of the ultra-violet radiation emitted by the sun that will pass through a thin film of silver, and finds that the percentage variation of the radiation from day to day is large, having a standard deviation of 30 per cent. He suggests that the ordinary haziness of the atmosphere is due to large particles which scatter all wave-length alike, while the large variations in transparency which occur from day to day are chiefly due to scattering by particles which are small enough to scatter according to the inverse fourth power of the wave-length. A large increase in transparency occurred about June 1922, which may be connected with the marked change in the general weather which took place about that time. During the discussion Professor S. Chapman pointed out that the daily movements of the magnetic needle were attributed to electric currents in the upper atmosphere, and that the changes in the strength of these currents from time to time were probably due to variations in the conductivity of the atmosphere such as might be produced by fluctuations in the amount of ultra-violet light received from the sun. Thus we have a new reason for hoping that Major Dobson's pioneer work will be followed by systematic records of the intensity of the ultra-violet radiation.

Royal Meteorological Society

THE monthly meeting of the Society was held on Wednesday, October 15th, at 49, Cromwell Road, South Kensington, Capt. C. J. P. Cave, President, in the Chair.

L. F. Richardson, B.A., F.Inst.P.—The Brown Corona and the Diameters of Particles.

In this paper Mr. Richardson describes experiments made to determine the relation between the brown corona and the diameters of the particles by which it is produced. It is only on rare occasions that a corona with well defined coloured rings can be seen round sun or moon. Much more frequently there is only a brownish ring. Mr. Richardson compares the colour with that of the skin of a horse chestnut. It is desirable to estimate the size of the cloud particles from the dimensions of this ring. Other workers have concentrated attention on the brightly coloured rings, and information about the chestnut ring could only be found by experiment. With his usual versatility, Mr. Richardson devised half-a-dozen different experiments. He

found that the mean radius of the brown ring depended in part on the radius of the source of light as well as on the size of the diffracting obstacles. For practical use, it will probably be best to suppose the diameter of the corona estimated as so many times, say n times, the diameter of the sun or moon. In that case, the formula given by Mr. Richardson can be written with sufficient accuracy in the form—

Diameter of cloud particles in microns $= 230 \div (2n\text{-}1)$.

For example, if the apparent diameter of a corona is 5 times that of the moon, the average diameter of the cloud particles is 26μ, almost exactly the thousandth of an inch.

L. F. Richardson, B.A., F.Inst.P.—Photometric Observations on Clouds and Clear Skies.

Mr. Richardson's second paper is concerned mostly with the problem of determining from observations of a cloud how much water it contains. The most definite of his results was that a great thunder-cloud contained the equivalent of 2 millimetres of rain, less than the tenth of an inch.

L. J. Sutton, M.A., A.Inst.P.—Notes on Haboobs.

Haboobs are severe sandstorms of a type apparently confined almost entirely to the Sudan, where they are most frequent in the central region. Nearly all of them occur during the rainy season, *i.e.*, May to October, and at Khartoum, for example, they are experienced more than once a week during this period, and last about three hours on the average. Haboobs probably owe their origin to the heating up of a large region for four or five days, but, owing to the wide distances between meteorological stations in the Sudan, it has not been possible to discover where any particular haboob originated or to follow its track.

Correspondence

To the Editor, *The Meteorological Magazine*

The Reform of the Calendar

LOOKING over some papers that have accumulated during my absences abroad, I note a letter of Mr. H. A. Boys in the *Meteorological Magazine* for August about the reform of the calendar, in which he deprecates the division of the year into thirteen months of four weeks each, because with such a system of reckoning there could be no half-year or quarter-year.

I think he misses the point of the issue raised by Dr. Marvin of the United States Weather Bureau, who invites us to decide whether to build our meteorological statistics upon the day, the week and the year, all of which can be fairly well related to the

sun, or whether our guiding principal shall be some variable unit originally related to the moon, of which twelve heterogeneous specimens shall be put together to form a year. An important consideration is that the month is too long a unit for problems concerning the relation of weather to crops and other recurring phenomena, and the week or fortnight is for that purpose preferable; but no amount of ingenuity can make out a relation between the week and the calendar month, and we have as alternatives for practical purposes the week, with all its possible combinations, or the month, the whole month, and nothing but the month.

When the moon was the practical timekeeper for the human race, the month had a strong claim for consideration—salaries were paid thereby; one can form a picture of the members of some civil service, now defunct, pointing to the new moon as an undeniable certificate for a month's pay. Perhaps that was why so much ingenuity was spent in endeavouring to accommodate the division of the year into twelve new moons, but the efforts were not at all successful and the margin of error is too large for meteorological work.

In 1878 when the Meteorological Council began the issue of a weather report to meet the requirements of agriculture and hygiene, they chose the week as unit, but allowed it to wobble about the beginning of the year with an oscillation of three days on either side of the first day of the year. Even so, the files of the *Weekly Weather Report* are the best compendium of meteorological data in existence. Now the question is raised again, and we are at the parting of the ways. Shall we go whole-heartedly for the week as an accepted unit next in magnitude to the day, group the weeks as best we can and face the consequences? or shall we go on with an aggregation of heterogeneous months, dividing the year into twelve unequal parts and allowing no further sub-division except the day and its fractional parts?

At its recent meeting at Madrid, the Meteorological Section of the International Union for Geodesy and Geophysics agreed to approve and recommend as units of time for meteorological measurements (*inter alia*) :—

1. The mean solar day.
2. A week of 7 mean solar days.
3. A year consisting usually of 51 week-spells of 7 days each and 1 week-spell of 8 days; but in leap-year of 50 week-spells of 7 days each and 2 of 8 days each.

The possible grouping of the weeks was not considered, and the moon was tacitly allowed to disappear from the control of meteorological data.

I cordially agree with Mr. Boys that a "*dies non*," has no place in the organised study of weather. We have to take all the facts

in their turn as they come. That makes it of little importance for us whether the ordinal of the names of the days shall be the same in successive years or not.

Another resolution invited meteorologists who were specially interested in the reform of the calendar to circulate a calendar for 1925 (as a sort of New Year's card), setting out exactly how they would deal with the 365 or 366 days of meteorological data. I intend to try. If some acceptable method of dealing systematically with our data were disclosed, a committee of the League of Nations which has the reform of the calendar on its lap would doubtless be thankful.

NAPIER SHAW.

10, *Moreton Gardens, S.W.*5. *October 24th*, 1924.

High Pilot Balloon Ascent at Shoeburyness

May 28th, 1924

A VERY high pilot ballon ascent was carried out at Shoeburyness on May 28th, 1924. The balloon was followed with two theodolites up to a height of 50,000 feet, when the home station lost it, and for a further 14 minutes with one theodolite. The ascent, therefore, reached well into the stratosphere.

Up to a height of 16,000 feet the wind was south-easterly, averaging a speed of about 10 miles per hour. It then veered to south, decreasing slightly at first, then increasing to about 16 mph. at 25,000 feet. Beyond this height it continued to veer and increase, becoming south-west, 20 mph. at 30,000 feet. Beyond 40,000 feet it backed slowly and decreased. From 40,000 to 45,000 feet the wind averaged 13 mph. from west-south-west to south-south-west. At 50,000 feet the wind was west or west by south and very light. Before the balloon was lost by the home station, it had begun to descend slowly, showing evidence of a slight leak, and so no use was made of the readings obtained in the subsequent 14 minutes by the outstation only.

The balloon was a 150 inch pilot balloon. Its mean rate of ascent during the first 70 minutes was slightly in excess of the computed value, 500 feet per minute, but for the next 30 minutes the rate of ascent was somewhat irregular, having a mean value of about 360 feet per minute. After the 112th minute the balloon was definitely descending. The balloon was about 24½ miles distant when finally lost in the distance.

This pilot balloon reached well into the stratosphere, though there were no temperature observations available up to a sufficient height to determine the height of the tropopause. It should be noted, however, that there was no rapid change of wind at any stage of the ascent. The synoptic chart for 7 h. on May 28th showed a depression far out in the Atlantic, and an

anticyclone extending eastward from the southern Baltic. The pilot balloon showed the southerly circulation between the two.

The theodolites used were larger than those normally used at outstations. These instruments have been tried at Shoeburyness with 150 inch balloons with a view to obtaining ascents reaching into the stratosphere, but few really high ascents have been obtained, largely on account of unfavourable weather.

D. BRUNT.

Precision in Rainfall Measurement

IN reply to your comment on my letter in the October number of the *Meteorological Magazine*, p. 210, I should like to be allowed to say that the collecting bottle in the gauge, if its neck is a narrow one, as it should be, will not become dry in 24 hours. Experiment proves that so little evaporation takes place that its amount is quite negligible. The tendency is for the film of moisture to slowly drain to the bottom of the bottle, so that a few drops are always to be found there even when there has been no rain. If these few drops are spread over the inside of the bottle before inverting it over the measuring glass not a drop will fall into the measure unless the drainage is prolonged much beyond the period adopted when the bottle was deliberately wetted. But the drainage, both after deliberate wetting and when transferring rain to the measure, should always be for about the same length of time—say 2 minutes—so that a film of equal thickness is spread over the inside on both occasions.

Another and, for most observers, simpler way of obtaining the desired precision of measurement is the following. Let two bottles be used, but let them always be drained for 12 hours, both before placing in the gauge and when transferring their contents to the measure. The film of water on the interior will by this prolonged drainage, become so attenuated that its amount may be neglected without appreciable error.

M. J. SALTER.

Bank House, Mickletson, Campden, Gloucester. October 31st, 1924.

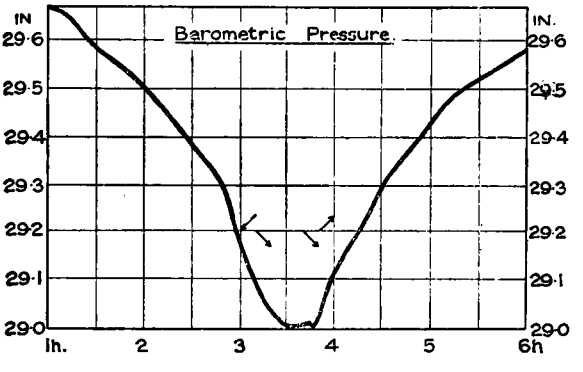
Report on Hurricane Experienced in Montserrat (West Indies)

August 28th, 1924

A SEVERE hurricane passed over the island of Montserrat on the morning of Thursday, August 28th, causing great damage to life and property. The first signs of the approaching hurricane were shown by the heavy swells from the north breaking along the shore during the afternoon of Wednesday. At this time the barometer stood at 29·872 in. A heavy rain storm was experi-

enced at 5 p.m., which seemed to clear the atmosphere, and there was no sign of the barometer falling until 9.30 p.m. on Wednesday night, when calm weather prevailed and the barometer registered 29·813. At midnight the wind blew a little stronger from the north-east. At 12.30 a.m. the barometer fell to 29·681, the wind increasing gradually in force. From this time the barometer was read every quarter of an hour and continued to fall. From 2 a.m. the intensity of the wind increased from north-east, and between 2 and 3.30 a.m. the barometer fell rapidly from 29·503 to 29·003. The wind then veered to north-west. At this time the velocity of the wind must have been somewhere in the region of 100 miles per hour, and around the Botanic station the largest trees fell at this time. The severest gust of wind was experienced between 3 and 4 a.m.

Botanic Station, Montserratt, 28th August, 1924.



At 15 minutes to 4 the barometer gave the first sign of rising slightly (29·015), but a minute after it again fell a trifle (29·007). At 5 minutes to 4 a decided rise to 29·075 was noticed. The wind was still blowing at hurricane proportions. From 4 a.m., when the barometer rose to 29·113, the wind veered to the south-west and decreased in force. This apparently indicated that the storm was travelling to the north. From 4·15 a.m. the wind then veered in decreasing severity from south-west to south and the barometer rose gradually to 29·621 at 6.30 a.m. At 10 a.m. in the morning the barometer registered 29·785, and at 3 p.m. the reading was 29·799. During the whole of the storm period the total precipitation was 8·25 in. There was no centre calm and from the above indications the centre passed north of Montserrat. From reliable sources the barometer was said to have recorded the very low readings of 28·6 in. at Olveston (north) and 28·5 in. at Farm (east districts). The Botanic station suffered very badly. Many valuable specimens were uprooted and the nursery and glass house damaged. The experimental plots were destroyed and valuable experiments lost. The scene after the storm was one of confusion because of the fallen trees and debris.

Apart from the very sad loss of life in the island, the loss in property and crops will amount to very many thousands of pounds. Among the heavier losses sustained must be mentioned

the serious damage to the cotton houses at Farm, Bethel, Trants, and Dagenham, approximately 160,000 lbs. of seed cotton were damaged. All the peasant sugar works were destroyed and the fruit trees, especially the breadfruit and avocado, sustained extensive damage and destruction. This will seriously affect the food supply of the peasantry for years to come.

The south of the island did not suffer as severely as the north-east and central districts. Reports from the far north are not yet to hand and the Assistant Curator is visiting this district to-day.

C. A. GOMEZ.

Botanic Station, Montserrat, West Indies. August 29th, 1924.

NOTES AND QUERIES

Daily Weather Charts for the South Atlantic

BY the general use of wireless telegraphy the preparation of daily weather charts covering a complete circuit of the northern hemisphere is now part of the routine of our meteorological services. The lacuna in high latitudes is being reduced in size as special meteorological stations are established in such regions as the coasts of Greenland and the far north of Canada. Meteorologists of the southern hemisphere have a more difficult task before them in gathering material for a daily chart of their part of the globe. In September 1923, the following resolution was adopted by the International Meteorological Conference at Utrecht. "It is highly desirable in the interest of synoptic meteorology in the southern hemisphere that meteorological observations should be transmitted by wireless stations from the islands of St. Helena, Ascension, Trinidad (Brazil), Tristan de Cunha and the South Orkneys to augment information from the surrounding coasts." We now learn that the Brazilian Government is equipping a station at Trinidad or rather Trindade (to give it the Portuguese name), a forlorn island, 700 miles east of the coast of Brazil, and 20° south of the equator. The station is to be occupied by navy men and there will be a 5 kilowatt radio equipment. There has been an important meteorological station at St. Helena since February 1892, and it may prove practicable before long to arrange for daily reports to be transmitted thence to South Africa and broadcasted with like information from Africa. A wireless station is being established at South Georgia, and it is expected that when this is finished, meteorological messages will be regularly transmitted, giving valuable information from this sub-Antarctic station.

If these new services prove of use to ships navigating the

South Atlantic as well as to the meteorological bureaux in South America and Africa, the development of similar services in other remote islands will not be long delayed.

Terrestrial Magnetism and Seismology at the Meteorological Office Observatories

IT is announced that the work in Terrestrial Magnetism at Kew Observatory, Richmond, Surrey, is to be terminated at the end of the year 1924. The underground room which has been occupied since 1858 by the magnetographs will be occupied by the Galitzin Seismographs which are to be transferred from Eskdalemuir Observatory, Dumfriesshire. The changes are being made by the authority of the Meteorological Committee and with the approval of the Gassiott Committee of the Royal Society.

The association of magnetic observations with Kew Observatory may be traced back as far as 1842 when the Committee of the Royal Society, which was reporting on the uses to which the Observatory could be put if it should be taken over by that body, included in their list :—

> " 3. As a station for trial and comparison of magnetical apparatus, and affording to observers desirous of acquiring a knowledge of the nature and use of such apparatus, an opportunity for conveniently doing so, and of obtaining a practical knowledge of the system of magnetical observation recommended by the Society.
>
> " 4. As a station in which many occasional phenomena might be advantageously observed by Fellows of the Society, or others, on permission obtained from the President and Council, such as, for example, concerted observations of shooting stars, &c., or in which the phenomena of what has been called " magnetic storms " or unusual magnetic disturbances might be witnessed, and their particulars attended to by observers desirous of so doing, without interfering with observations regularly in progress at official stations, or with a view to other circumstances in their phenomena than what may be ordinarily observed at such stations : it being considered that such " storms " are sometimes of considerable duration, and may become known to exist by direct communication from Greenwich or other regular observing station."

It will be remembered that " it did not appear to the Council [of the Royal Society] to be expedient for the Society to occupy the Observatory at Kew." The supporters of the scheme for utilising the Observatory obtained the support of the British Association, and that body accepted the responsibility. For the first ten years Sir Francis Ronalds acted as Honorary Superintendent. It was in 1850 that regular magnetic observations were commenced with instruments provided by Lieut.-Col. Sabine. The first magnetic self-recording instruments were set up by Ronalds. The permanent ones were constructed after Walsh had become Superintendent, " very consider-

able improvement having been made in the art of photography." The instruments were completed at an expense not exceeding £250, derived from the Government Grant Fund. These same magnetographs have been in operation ever since, though the records were interrupted in 1874 and again when extensive alterations were being made in the Observatory in 1913. The records have been thoroughly discussed, and it is much to be regretted that the series could not be continued indefinitely. Since 1901 their use has been sadly impaired, however, by the electrification of the tramways and railways in the neighbourhood. This evil was anticipated. In 1908 the Observatory at Eskdalemuir, 17 miles from the nearest railway line, was opened by the National Physical Laboratory (then responsible for Kew Observatory), the cost of erection of the new observatory having been defrayed in part by the London United Tramways Company.

As another off-shoot from Kew, we have the observatory established at Lerwick in the Shetland Islands in 1921.

The magnetographs at the Royal Observatory, Greenwich, have recently been affected in the same way as those at Kew Observatory, and a new magnetic observatory has been built by the Greenwich authorities at Abinger in Surrey, close to Leith Hill. This observatory is now in operation and is free from disturbance, so that there are four magnetic observatories with continuous and "undisturbed" records in the British Isles: Lerwick, Eskdalemuir, Stonyhurst (the Jesuit College, near Blackburn), and Abinger. The study of terrestrial magnetism in Great Britain is therefore well provided for.

Publication of the magnetic results from Lerwick and Eskdalemuir will be carried out by the Meteorological Office, while the Astronomer Royal and the authorities at Stonyhurst College are respectively responsible for the publication of results from Abinger and Stonyhurst.

As to seismology, an undamped Milne Seismograph recording earth tilts in the East-West direction has been in operation at Kew since 1898. This instrument is now, however, regarded as obsolete because only the damped boom type of seismograph, best exemplified by the Galitzin instrument, enables a seismologist to identify the amplitudes and times of arrival of the various phases of an earthquake disturbance and so to determine with some accuracy the direction and distance of the epicentre. This determination can be made from the records of a single observatory provided three seismographs are installed to record earth tilts in three directions mutually at right angles. The installation at Eskdalemuir of three such instruments of the Galitzin type, which was rendered possible in 1910 by the generosity of Sir Arthur Schuster, F.R.S., is the finest in this country,

and the transfer of the installation to Kew will, it is hoped, expedite the issue of bulletins notifying the occurrence of considerable earthquakes.

Exposure of Thermometer Screens

OFFICIAL books of instruction recommend that thermometer screens should be exposed in the open, and state that the distance of every object near the screen should be at least twice the height of the object. Questions have recently been raised as to the effect of a wood upon readings of a thermometer exposed inside it, the readings being compared with similar observations taken under normal conditions. Some information on this point is contained in the following tables showing a comparison of temperature in two Stevenson Screens at Belper, Derbyshire.

TABLE I.

MONTHLY MEAN MAXIMUM AND MEAN MINIMUM TEMPERATURES FOR THE PERIOD MAY, 1914 TO APRIL, 1916.

MONTH.	MAXIMUM.		MINIMUM.		MONTH.	MAXIMUM.		MINIMUM.	
	Field Head House.	Quarry Bank.	Field Head House.	Quarry Bank.		Field Head House.	Quarry Bank.	Field Head House.	Quarry Bank.
1914	°F	°F	°F	°F	1915	°F	°F	°F	°F
May	58·4	59·6	42·2	41·3	May	59·7	61·0	42·2	41·5
June	66·5	68·3	49·0	47·7	June	67·0	69·6	46·8	45·6
July	67·7	69·3	53·5	52·5	July	65·1	66·9	50·2	49·2
Aug.	68·4	70·1	51·9	50·5	Aug.	66·3	68·2	51·8	50·3
Sept.	63·6	64·8	46·6	45·4	Sept.	63·3	65·0	47·3	45·5
Oct.	55·4	55·8	44·4	43·7	Oct.	53·2	53·6	41·7	41·2
Nov.	48·5	49·1	38·4	36·8	Nov.	42·9	43·2	32·1	30·8
Dec.	43·7	43·7	34·4	33·9	Dec.	45·3	45·4	35·3	34·8
1915					1916				
Jan.	42·5	42·5	34·4	34·1	Jan.	49·5	49·4	39·5	38·9
Feb.	44·3	44·5	32·5	32·1	Feb.	41·7	41·8	32·3	32·4
Mar.	47·5	47·9	34·5	34·1	Mar.	41·1	41·5	32·5	32·5
April	53·4	53·9	37·6	37·3	April	55·2	55·4	38·0	37·1

The observations were made in 1914-1916 by Mr. John Hunter, who has contributed regular observations, first to the Royal Meteorological Society and later to the Meteorological Office, since 1877.

The screens are set up respectively at Field Head House and at Quarry Bank, at elevations above M.S.L. of about 340 feet and 280 feet. They are about ½ mile apart. The screen at Field Head House is sheltered by a large tree and is also close to a house; that at Quarry Bank is exposed normally.

TABLE II.

AVERAGE MONTHLY DIFFERENCE OF MEAN MAXIMUM AND MEAN MINIMUM TEMPERATURE FOR THE TWO STATIONS. (DEGREES FAHRENHEIT)

	Jan.	Feb.	Mar.	Apl.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
					MAXIMUM.							
Quarry Bank above Field Head	0·0	0·1	0·4	0·3	1·2	2·2	1·7	1·8	1·4	0·4	0·4	0·0
					MINIMUM.							
Field Head above Quarry Bank	0·4	0·1	0·2	0·6	0·8	1·2	1·0	1·4	1·5	0·6	1·4	0·5

It will be seen that except during December and January the maximum temperature under the tree is less than that given by the normal exposure, and that the minimum temperature under the tree is invariably the higher of the two. The differences are in general most marked in summer, but the seasonal effect is less regular in the case of the minimum temperature. In the case of the maximum temperature the greatest difference in any single month was 2·6°F. in June, 1915; January, 1916, showed a reversal, the sheltered thermometer being 0·1°F. higher than the normally exposed one. In the case of the minimum temperature the greatest difference was 1·8°F. in September, 1915, and here again a reversal occurred in one month, the sheltered thermometer being 0·1°F. lower than the normally exposed one in February, 1916.

The variations tend to balance one another and the effect on the mean temperature is very small. The maximum differences of mean temperature are 0·5°F. in June and November, the normally exposed thermometers giving the highest value in June and the lowest in November. On the whole year the mean works out about 0·3°F. higher in the case of the normal exposure.

Dry Decks in Sea Fog

ON my voyage from Canada in the "Empress of Scotland" after the British Association Meeting, I made an observation which illustrates the extent to which heat rays from the sun penetrate fog. On September 1st, in mid-Atlantic we were in thick and uniform fog. On the sheltered decks everything was dripping, but the boat-deck, where it had no shelter over it, was quite dry. The most remarkable contrast was provided by the rail of a ladder leading to the boat-deck. The lower half of this rail was sheltered by the deck and wet, the upper half was dry. One would expect the contrast between the sheltered and unsheltered parts of the boat to disappear at sun-down, and I should have liked to have confirmed this, but on the night in question the circumstances were altered by drizzle setting in.

F. J. W. WHIPPLE.

Radiation from the Sky

RADIATION MEASURED AT BENSON, OXON, 1924.

Unit: one gramme calorie per square centimetre per day.

ATMOSPHERIC RADIATION only (dark heat rays).

Averages for Readings about time of Sunset.

		July	Aug.	Sept.
Cloudless days:—				
Number of readings	n	12	5	6
Radiation from sky in zenith ...	πI	585	542	521
Total radiation from sky ...	J	629	581	555
Total radiation from horizontal black surface on earth ...	X	799	737	722
Net radiation from earth ...	X—J	170	156	167

DIFFUSE SOLAR RADIATION (luminous rays).

Averages for Readings between 9 h. and 15 h. G.M.T.

Cloudless days:—				
Number of readings	n_0	3	0	2
Radiation from sky in zenith ...	πI_0	59	—	28
Total radiation from sky ...	J_0	57	—	38
Cloudy days:—				
Number of readings	n_1	3	5	3
Radiation from sky in zenith ...	πI_1	178	83	97
Total radiation from sky ...	J_1	154	75	81

Unit for I = gramme calorie per day per steradian per square centimetre.

Unit for J and X = gramme calorie per day per square centimetre.

For description of instrument and methods of observation, see *The Meteorological Magazine*, October, 1920, and May, 1921.

The Testing of Rain Gauges

A NEW edition of the pamphlet dealing with the conditions under which tests on volumetric glassware are made has been issued recently by the National Physical Laboratory. It is interesting to note that with regard to rain-gauges the rule is that the mark of the Laboratory is placed on funnels and measures which conform with the specifications adopted by the Air Ministry, Meteorological Office. Similarly in the case of self-recording gauges, only those types which are approved by the Meteorological Office are now accepted for test.

It is explained how the test of a vessel such as a rain-gauge measure is carried out. " The adjustment of a water meniscus

to a mark on a vessel is made so that the lowest point of the meniscus is in the plane which contains the mark . . . . The meniscus is shaded by folding a strip of black paper round the vessel, the top edge of the paper being not more than 1 mm. below the mark on which the setting is to be made. The meniscus so shaded is viewed against a white background."

Our Sins of Omission

OUR contemporary *Ciel et Terre* in a light-hearted review of the note on "The Influence of Climatic Conditions on the Shape of the Nose," published in the July issue of this magazine, points out that we omitted to give any reference to the journal in which the original article was published. We hasten to say that it appeared in the Journal of the Royal Anthropological Institute, London, Vol. 53, 1923, p. 92.

It has also been brought to our notice that in the October number of the magazine in the note on the "Ballon Sonde Ascent over the Sea," we give the temperature readings only in degrees absolute. The temperatures in degrees Fahrenheit were, at sea level 68°, at 1 km. (3,300 ft.) 61°, at 3 km. (9,900 ft.) 43°, and at 5·4 km. (17,800 ft) 12°.

News in Brief

THE "Jevons Memorial" Lectures for 1924-5 are being given by Mr. R. H. Hooker, at Universtity College, London, on Fridays, November 7th, 14th, 21st and 28th, at 5.30 p.m. The subject is "The Weather and the Crops, Part II.—Economic Effects." The lectures are open to the public without fee or ticket.

The Weather of ~~June~~ October, 1924

UNSETTLED rainy conditions prevailed generally throughout the month except for a few periods of finer drier weather. During the first days most of the rainfall occurred in the west, and fine sunny weather with early morning mist or fog was experienced in the eastern counties. On the 4th, however, a depression over the Bay of Biscay began to move northwards and rain became general over the whole country, *e.g.*, on the 5th 58 mm. (2·26 in.) were reported from Ilderton (Northumberland), 53 mm. (2·09 in.) from Nairn, 16 mm. (0·63 in.) from Gorleston, and 9 mm. (0·35 in.) from Roches Point. On the 7th a secondary depression developed off the mouth of the English Channel and moving eastwards caused high winds and gales with much heavy rain in the south-western districts of England. More than 25 mm. (1 in.) fell over a broad belt extending from Land's End to Worcester and Warwick, and more than 50 mm. (2 in.) over the greater part of

Cornwall. Among the largest measurements were 88 mm. (3·46 in.) at St. Austell, Cornwall (where the observer reports that it was "the wettest day recorded since 1865"), 83 mm. (3·27 in.) at Falmouth (which constituted a record value for 24 hours for that station), and 82 mm. (3·22 in.) at Penzance. In some parts, especially Cornwall, serious floods resulted. Conditions remained unsettled for a few days after this, but by the 12th the anticyclone over Central Europe spread across Great Britain and fairer, drier weather set in in most districts for about a week. Sunshine reports of over 9 hours duration were registered on several days, notably on the 13th and 14th when the temperature rose above 70° F. at many places, Colwyn Bay reporting 73° F., Cambridge, Manchester, Aberystwyth and Croydon, 72° F. on the 13th, and Kilmarnock 72° F. on the 14th. During this period mist and fog occurred locally at night and in the early morning, and thunderstorms were experienced at a few stations in the south and east of Ireland on the 12th and 13th. On the 18th the approach of another depression from the Atlantic caused a renewal of unsettled weather over the whole country and heavy rain in the west. This spread also to the east of the country on the 21st, when more than 25 mm. (1 in.) were recorded over an area extending from Derbyshire to Norfolk and Suffolk; 43 mm. (1·69 in.) were measured at Geldeston (near Beccles) and 36 mm. (1·42 in.) at Cambridge. Near Saxmundham considerable floods occurred. On the morning of the 22nd high winds and gales were experienced along the south-eastern coasts. After this, anticyclonic conditions prevailed for a few days, during which time the lowest temperatures for the month were registered, many of the temperatures on the ground being unusually low for the time of year, *e.g.* 17° F. at Achnashellach, and 19° F. at Inverness and Wisley. During the last few days there was a renewal of mild, unsettled weather with further heavy rain at times. Thunderstorms accompanied by hail occurred in the south-eastern parts of England on the 30th.

Mean pressure during October was below normal over the British Isles, the North Atlantic, Iceland and Spitzbergen, the maximum deficit (6·9 mb.) being recorded at Reykjavik (Iceland). Elsewhere, the pressure was above normal, the excess reaching 6·1 mb. at Vardo, 5·7 mb. at Bornholm, and 3·0 mb. at Nice. Winds were mainly from S or S W over western Europe, and from S E over eastern Europe, resulting in an excess of rainfall in the west and a deficit in the east. Temperature was above normal over the whole of Europe, the excess being greatest in the north (Haparanda + 7·7° F.) After a fortnight of generally unsettled weather, a few fine days with local mist or fog occurred. [The opportunity was seized for the flight of the Zeppelin ZR3

from Germany to the United States. She started under ideal weather conditions on the European side, but met with adverse winds after passing the Azores.] A period of alternating fine and stormy days followed, with gales and some heavy falls of rain. On the nights of the 21st and 22nd, a gale raged in the eastern Atlantic and North Sea. A Swedish steamer was wrecked, and, owing to the heavy seas, rescue work was impossible. Snow was reported from Russia, Iceland and Switzerland, where about two feet of snow fell at Santis on the 30th. In France, floods were caused both by the rising of the rivers and also by inundation from the sea on the Channel coast. At the end of the month, the Rhine and Meuse were in flood, and river traffic was mostly stopped. The Mediterranean region experienced mainly fair weather, many temperatures of about 80° F. being recorded, but there were some heavy falls of rain and a gale off Sicily on the 7th.

The floods in India reported last month, began to subside early in October. The rains for the week ending on the 15th, were heavy in the United Provinces and in the Central Provinces, and continued scanty in the north-west, in Central India (East), Mysore and Madras. For the week ending on the 22nd, the rain was for the most part normal. In eastern Siberia, the river Amur has been in flood, a rise of twelve feet in the level causing a loss of 400 lives. Typhoons causing damage and loss of life visited the Philippines on the 8th, and the coast of Annam on the 23rd and 24th.

The report on the crops of Canada is not very favourable. Damage has been caused through the rainy weather which delayed the threshing of the wheat, and in some parts by frost.

At Mantua (Cuba), on the 20th, and in Nicaragua, torrential rains and floods destroyed many buildings, with loss of life. In Cuba, the tobacco crop suffered severely.

The special message from Brazil states that the rainfall was scanty over the whole country, and was 24 mm. and 86 mm. below normal in the central and southern districts respectively. Fewer anticyclones passed across the country than in the last two or three months, but the continental depression was more active. There was a general improvement in the crops owing to the small amount of precipitation. At Rio de Janeiro pressure was 1 mb. above normal, and temperature ·7° F. below normal, the maximum temperatures during the month being unusually below.

Rainfall October, 1924: General Distribution

England and Wales	132	per cent. of the average 1881-1915.
Scotland	97	
Ireland	97	
British Isles	115	

Rainfall: October, 1924: England and Wales.

CO.	STATION.	In.	mm.	Per-cent. of Av	CO.	STATION.	In.	mm.	Per-cent. of Av.
Lond.	Camden Square.....	3·52	89	134	*War.*	Birminghm, Edgbaston	4·35	110	156
Sur .	Reigate, Hartswood...	3·41	87	108	*Leics*	Leicester Town Hall...	4·13	105	...
Kent.	Tenterden, View Tower	4·57	116	131	,, .	Belvoir Castle.....	4·40	112	163
,, .	Folkestone, Boro. San.	4·59	116	...	*Rut* .	Ridlington.....	4·85	123	...
,, .	Broadstairs	3·52	89	114	*Linc.*	Boston, Skirbeck	4·06	103	148
,, .	Sevenoaks, Speldhurst.	3·81	97	...	,, .	Lincoln, Sessions House	4·08	104	160
Sus .	Patching Farm.....	5·30	135	134	,, .	Skegness, Estate Office.	4·07	103	149
,, .	Eastbourne, Wilm. Sq.	4·11	104	99	,, .	Louth, Westgate	3·91	99	121
,, .	Tottingworth Park....	6·39	162	154	,, .	Brigg	3·98	101	133
Hants	Totland Bay, Aston...	5·43	138	133	*Notts.*	Worksop, Hodsock....	4·04	103	154
,, .	Fordingbridge, Oaklnds	4·96	126	120	*Derby*	Mickleover, Clyde Ho..	4·02	102	149
,, .	Portsmouth, Vic. Park.	5·35	136	145	,, .	Buxton, Devon. Hos...	7·18	182	146
,, .	Ovington Rectory	4·75	121	117	*Ches.*	Runcorn, Weston Pt...	4·19	106	122
,, .	Grayshott	4·59	117	110	,, .	Nantwich, Dorfold Hall	4·13	105	...
Berks	Wellington College...	3·67	93	112	*Lancs*	Bolton, Queen's Park .	5·39	137	...
,, .	Newbury, Greenham..	4·07	103	116	,, .	Stonyhurst College....	4·74	120	106
Herts.	Bennington House....	4·11	104	151	,, .	Southport, Hesketh...	4·02	102	114
Bucks	High Wycombe	3·62	92	116	,, .	Lancaster, Strathspey.	5·35	136	...
Oxf. .	Oxford, Mag. College..	3·63	92	130	*Yorks*	Sedbergh, Akay	6·29	160	126
Nor .	Pitsford, Sedgebrook..	3·75	95	140	,, .	Wath-upon-Dearne ...	3·26	83	118
,, .	Eye, Northolm.....	4·34	110	...	,, .	Bradford, Lister Pk...	3·01	76	86
Beds.	Woburn, Crawley Mill.	4·03	102	149	,, .	Oughtershaw Hall	7·37	187	...
Cam.	Cambridge, Bot. Gdns.	3·60	91	153	,, .	Wetherby, Ribston H..	2·90	74	97
Essex	Chelmsford, CountyLab	3·59	91	...	,, .	Hull, Pearson Park ...	3·63	92	122
,, .	Lexden, Hill House...	3·97	101	...	,, .	Holme-on-Spalding ...	3·51	89	...
Suff .	Hawkedon Rectory ...	4·10	104	152	,, .	Lowthorpe, The Elms.	3·78	96	116
,, .	Haughley House.....	3·37	86	...	,, .	West Witton, Ivy Ho..	3·47	88	...
Norf.	Beccles, Geldeston....	4·52	115	160	,, .	Pickering, Hungate ...	3·99	101	...
,, .	Norwich, Eaton	4·20	107	135	,, .	Middlesbrough	3·05	77	102
,, .	Blakeney	3·75	95	143	,, .	Baldersdale, Hury Res.	...	..	...
,, .	Swaffham	3·94	100	137	*Durh.*	Ushaw College	3·13	79	91
Wilts.	Devizes, Highclere....	5·21	132	168	*Nor* .	Newcastle, Town Moor.	3·99	101	125
Dor .	Evershot, Melbury Ho.	5·45	138	118	,, .	Bellingham Manor....	3·49	89	...
,, .	Weymouth, Westham..	5·34	135	146	,, .	Lilburn Tower Gdns...	4·27	109	...
,, .	Shaftesbury, Abbey Ho.	5·59	142	143	*Cumb*	Penrith, Newton Rigg..	3·46	88	91
Devon	Plymouth, The Hoe...	7·09	180	180	,, .	Carlisle, Scaleby Hall .	3·34	85	100
,, .	Polapit Tamar	6·49	165	135	,, .	Seathwaite	10·00	254	83
,, .	Ashburton, Druid Ho..	9·02	229	149	*Glam.*	Cardiff, Ely P. Stn.....	6·36	161	133
,, .	Cullompton	5·33	135	129	,, .	Treherbert, Tynywaun	12·05	306	...
,, .	Sidmouth, Sidmount ..	6·19	157	166	*Carm*	Carmarthen Friary....	5·85	149	103
,, .	Filleigh, Castle Hill ...	6·67	169	...	,, .	Llanwrda, Dolaucothy.	7·52	191	119
,, .	Hartland Abbey.....	5·96	151	...	*Pemb*	Haverfordwest, Portf'd	...	..	...
Corn.	Redruth, Trewirgie	9·52	242	181	*Card.*	Gogerddan.....	5·81	148	110
,, .	Penzance, Morrab Gdn.	8·45	215	181	,, .	Cardigan, County Sch. .	4·35	111	...
,, .	St. Austell, Trevarna..	10·44	265	198	*Brec.*	Crickhowell, Talymaes	9·00	229	...
Soms	Chewton Mendip	7·44	189	154	*Rad* .	Birm. W. W. Tyrmynydd	6·99	177	106
,, .	Street, Hind Hayes ...	5·36	136	...	*Mont.*	Lake Vyrnwy	8·76	223	154
Glos. .	Clifton College	6·44	163	171	*Denb.*	Llangynhafal	3·58	91	...
,, .	Cirencester	5·04	128	148	*Mer* .	Dolgelly, Bryntirion..	5·58	142	92
Here.	Ross, County Obsy.	...	..	...	*Carn.*	Llandudno	3·19	81	89
,, .	Ledbury, Underdown.	3·81	97	124	,, .	Snowdon, L. Llydaw 9	12·97	329	...
Salop	Church Stretton.....	5·14	131	142	*Ang* .	Holyhead, Salt Island.	3·28	83	82
,, .	Shifnal, Hatton Grange	3·42	87	121	,, .	Lligwy	3·38	86	...
Staff.	Tean, The Heath Ho...	4·82	122	149	*Isle of Man*				
Worc.	Ombersley, Holt Lock.	3·98	101	149		Douglas, Boro' Cem...	3·28	83	71
,, .	Blockley, Upton Wold.	5·37	136	164	*Guernsey*				
War.	Farnborough.....	4·21	107	133		St. Peter Port, Grange.	5·27	134	117

Erratum Broadstairs for September, 2·85 in. 72 mm., 145 %

Rainfall: October, 1924: Scotland and Ireland

CO.	STATION	In.	mm.	Per-cent. of Av.	CO.	STATION.	In.	mm.	Per-cent. of Av.
Wigt.	Stoneykirk, Ardwell Ho	...	..	...	*Suth.*	Loch More, Achfary...	7·02	178	90
,, .	Pt. William, Monreith .	2·89	73	...	*Caith*	Wick	2·35	60	79
Kirk.	Carsphairn, Shiel.	4·55	116	...	*Ork .*	Pomona, Deerness	3·35	85	88
,, .	Dumfries, Cargen.....	3·89	99	89	*Shet .*	Lerwick	3·05	77	77
Dum	Drumlanrig	4·74	120	110					
Roxb	Branxholme	3·11	79	96	*Cork.*	Caheragh Rectory	5·60	142	...
Selk .	Ettrick Manse.....	4·19	106	...	,, ..	Dunmanway Rectory.	5·99	152	100
Berk.	Marchmont House	3·38	86	88	,, ..	Ballinacurra	4·32	110	106
Hadd	North Berwick Res....	3·78	96	128	,, ..	Glanmire, Lota Lo. ...	4·34	110	105
Midl	Edinburgh, Roy. Obs..	3·39	86	131	*Kerry*	Valencia Obsy.	5·30	135	95
Lan .	Biggar	2·89	73	96	,, .	Gearahameen	7·10	180	...
Ayr .	Kilmarnock, Agric. C..	3·24	82	92	,, .	Killarney Asylum.....	4·40	112	82
,, .	Girvan, Pinmore.....	3·24	82	65	,, .	Darrynane Abbey	5·68	144	113
Renf.	Glasgow, Queen's Pk..	2·97	75	91	*Wat .*	Waterford, Brook Lo..	4·00	102	102
,, .	Greenock, Prospect H..	4·07	103	76	*Tip .*	Nenagh, Cas. Lough...	4·32	110	127
Bute.	Rothesay, Ardencraig.	3·91	99	89	,, .	Tipperary	4·22	107	...
,, .	Dougarie Lodge	3·31	84	...	,, .	Cashel, Ballinamona ..	3·67	93	102
Arg .	Glen Etive.....	7·21	183	...	*Lim .*	Foynes, Coolnanes	4·47	113	121
,, .	Oban	4·44	113	...	,, .	Castleconnell Rec.	4·66	118	...
,, .	Poltalloch	4·79	122	97	*Clare*	Inagh, Mount Callan ..	7·30	185	...
,, .	Inveraray Castle.....	6·71	170	95	,, .	Broadford, Hurdlest'n.	5·14	131	...
,, .	Islay, Eallabus.....	4·79	122	100	*Wexf*	Newtownbarry	3·44	87	...
,, .	Mull, Benmore	13·60	345	...	,, .	Gorey, Courtown Ho...	2·97	75	84
Kinr.	Loch Leven Sluice	3·34	85	97	*Kilk.*	Kilkenny Castle	2·89	73	92
Perth	Loch Dhu	6·30	160	88	*Wic .*	Rathnew, Clonmannon	2·06	52	...
,, ..	Balquhidder, Stronvar.	5·33	135	78	*Carl .*	Hacketstown Rectory .	3·18	81	84
,, ..	Crieff, Strathearn Hyd.	3·87	98	98	*QCo..*	Blandsfort House.....	3·32	84	94
,, ..	Blair Castle Gardens ..	4·25	108	...	,,	Mountmellick	3·42	87	...
,, .	Coupar Angus School..	3·82	97	134	*KCo.*	Birr Castle.....	3·30	84	113
Forf.	Dundee, E. Necropolis.	4·72	120	177	*Dubl.*	Dublin, FitzWm. Sq...	1·56	40	58
,, .	Pearsie House.....	5·53	141	...	,, .	Balbriggan, Ardgillan .	2·20	56	81
,, .	Montrose, Sunnyside..	4·52	115	164	*Me'th*	Drogheda, Mornington	2·59	66	...
Aber.	Braemar Bank	3·00	76	80	*W.M*	Mullingar, Belvedere .	4·09	104	131
,, .	Logie Coldstone Sch. ..	3·80	97	117	*Long*	Castle Forbes Gdns....	3·09	79	95
,, .	Aberdeen, Cranford Ho	3·43	87	106	*Gal .*	Galway, Waterdale ...	...	..	...
,, .	Fyvie Castle	2·91	74	...	,, .	Ballynahinch Castle ..	8·56	217	...
Mor .	Gordon Castle.....	3·43	87	109	*Mayo*	Mallaranny.....	6·94	176	...
,,	Grantown-on-Spey....	3·16	80	106	,, .	Westport House.....	4·66	118	104
Na .	Nairn, Delnies.....	3·48	88	148	,, .	Delphi Lodge	9·70	246	...
Inv..	Ben Alder Lodge	4·34	110	...	*Sligo*	Markree Obsy.	4·70	119	116
,, .	Kingussie, The Birches	1·96	50	...	*Ferm*	Enniskillen, Portora ..	3·44	87	...
,, .	Fort Augustus	...	..	...	*Arm.*	Armagh Obsy.	2·77	70	102
,, .	Loch Quoich, Loan....	9·00	229	...	*Down*	Warrenpoint	3·49	89	...
,, .	Glenquoich	7·46	189	75	,, .	Seaforde	3·57	91	100
,, .	Inverness, Culduthel R.	2·30	59	...	,, .	Donaghadee	2·21	56	77
,, .	Arisaig, Faire-na-Squir	5·42	138	...	,, .	Banbridge, Milltown .	2·70	69	98
,, .	Fort William.....	5·42	138	77	*Antr.*	Belfast, Cavehill Rd. ..	2·71	69	...
,, .	Skye, Dunvegan.....	6·56	167	...	,, .	Glenarm Castle.....	1·96	50	...
,, .	Barra, Castlebay	3·22	82	...	,, .	Ballymena, Harryville	2·99	76	81
R&C	Alness, Ardross Cas. ..	2·28	58	59	*Lon .*	Londonderry, Creggan	3·45	88	94
,, .	Ullapool.....	4·05	103	...	*Tyr .*	Donaghmore	2·20	56	...
,, .	Torridon, Bendamph..	6·49	165	81	,, .	Omagh, Edenfel	3·03	77	83
,, .	L. Carron, Plockton...	...	..	...	*Don .*	Malin Head	2·90	73	98
,, .	Stornoway	4·97	126	96	,, .	Rathmullen.....	...	..	...
Suth.	Lairg	3·36	85	...	,, .	Dunfanaghy	2·56	65	58
,, .	Tongue Manse.....	2·78	71	66	,, .	Killybegs Rockmount.	5·87	149	105
,, .	Melvich School.....	1·99	51	54					

Climatological Table for the British Empire, May, 1924

STATIONS	PRESSURE		TEMPERATURE							Relative Humidity	Mean Cloud Am'nt	PRECIPITATION			BRIGHT SUNSHINE	
			Absolute		Mean Values				Mean							
	Mean of Day M.S.L.	Diff. from Normal	Max.	Min.	Max.	Min.	½ max. and min.	Diff. from Normal	Wet Bulb.			Am'nt	Diff. from Normal	Days	Hours per day	Percentage of possible.
	mb.	mb.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	%	0—10	mm.	mm.			
London, Kew Obsy.	1012·3	— 3·6	75	38	64·0	47·7	55·9	+ 2·5	53·6	74	6·5	61	+ 17	19	5·9	38
Gibraltar	1015·8	— 0·3	88	52	76·1	59·5	67·8	+ 2·3	60·9	69	3·3	10	— 34	4	...	...
Malta	1017·2	+ 3·5	84	57	74·7	63·2	68·9	+ 3·8	62·7	70	2·9	0	— 10	0	10·8	77
Sierra Leone	1011·8	+ 0·1	94	70	89·6	73·8	81·7	— 0·3	77·5	73	5·3	191	— 92	18	...	...
Lagos, Nigeria	1009·3	— 1·7	99	72	90·3	77·1	83·7	+ 2·5	78·5	71	5·1	88	—175	9	...	...
Kaduna, Nigeria	1013·0	— 0·1	100	65	92·5	70·0	81·3	+ 1·9	73·0	66	0·9	108	— 78	15	...	...
Zomba, Nyasaland	1013·6	— 0·7	83	49	78·3	56·0	67·1	+ 1·4	...	92	3·1	4	— 21	2	...	...
Salisbury, Rhodesia	1015·2	— 2·9	83	38	76·4	48·1	62·3	+ 1·8	54·0	53	1·0	0	— 12	0	...	...
Cape Town	1019·4	+ 1·5	77	40	65·1	48·6	56·9	— 1·7	53·8	80	5·1	49	— 52	10	...	...
Johannesburg	1019·7	— 0·2	71	32	63·5	45·1	54·3	— 0·1	45·2	63	2·8	29	+ 11	4	8·6	80
Mauritius	1016·2	— 0·2	81	61	78·1	68·4	73·2	+ 0·6	69·1	81	6·2	94	+ 17	13	5·7	51
Bloemfontein	...	...	75	28	66·4	37·4	51·9	— 0·8	43·1	71	2·0	4	— 26	2	...	...
Calcutta, Alipore Obsy.	1003·6	+ 0·1	102	72	98·6	79·7	89·1	+ 3·1	79·7	73	5·3	26	—120	*4	...	...
Bombay	1006·5	— 1·2	94	79	92·9	81·6	87·3	+ 1·6	78·1	68	4·0	0	— 18	*0	...	...
Madras	1005·0	— 0·4	107	78	98·0	82·0	90·0	+ 0·1	78·3	57	4·5	0	— 27	*0	...	...
Colombo, Ceylon	1007·7	— 0·5	91	73	87·6	76·9	82·3	— 0·5	79·4	77	8·8	552	+241	29	5·6	45
Hong Kong	1008·3	— 1·1	88	73	84·4	76·7	80·5	+ 3·1	75·4	82	7·8	429	+132	13	6·0	46
Sandakan	...	...	90	74	87·9	75·8	81·9	— 0·7	77·3	81	...	425	+273	17	...	...
Sydney	1021·1	+ 2·5	80	43	67·7	51·2	59·5	+ 0·9	54·0	68	4·4	73	— 59	10	6·0	58
Melbourne	1021·0	+ 1·5	69	36	60·4	45·7	53·1	— 1·0	49·8	72	6·2	21	— 34	12	4·0	39
Adelaide	1021·0	+ 0·9	81	41	66·3	49·3	57·8	0·0	50·9	61	4·8	62	— 7	14	5·3	52
Perth, W. Australia	1016·9	— 1·9	85	43	70·1	53·0	61·5	+ 1·1	55·5	67	5·9	126	+ 7	17	5·3	51
Coolgardie	1017·9	— 1·9	87	37	71·2	47·9	59·5	+ 1·9	52·5	47	3·4	14	— 21	7	...	...
Brisbane	1020·6	+ 1·8	81	43	73·7	54·5	64·1	— 0·3	60·0	67	4·2	33	— 42	7	6·9	65
Hobart, Tasmania	1016·8	+ 1·2	69	36	57·9	43·9	50·9	+ 0·5	46·8	74	5·8	20	— 27	12	5·1	53
Wellington, N.Z.	1015·8	+ 0·6	66	36	59·0	47·3	53·1	+ 0·3	49·5	77	6·5	93	— 27	15	3·6	37
Suva, Fiji	1015·7	+ 2·9	88	70	80·9	72·6	76·7	+ 0·2	74·0	84	7·8	451	+193	25	...	...
Kingston, Jamaica	1013·0	— 0·1	93	70	89·8	73·2	81·5	+ 1·8	74·9	64	6·0	0	—110	0	...	...
Grenada, W.I.	1013·8	+ 1·2	89	72	85·8	74·7	80·3	+ 0·8	75·3	75	3·7	136	+ 18	20	...	...
Toronto	1009·5	— 5·3	69	30	58·6	41·5	50·1	— 2·6	44·5	71	6·0	112	+ 36	16	6·5	44
Winnipeg	1015·3	+ 1·0	74	22	56·9	32·7	44·8	— 6·8	45·3	76	4·9	10	— 47	5	7·8	51
St. John, N.B.	1010·5	— 3·5	65	32	55·6	39·9	47·7	0·0	43·8	74	7·0	107	+ 13	10	6·2	42
Victoria, B.C.	1018·8	+ 2·4	83	37	62·4	46·9	54·7	+ 1·6	48·5	72	4·4	2	— 31	2	10·1	66

* For Indian stations a rain day is a day on which 0·1 in. (2·5 mm.) or more rain has fallen.

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Air Ministry :: Meteorological Office

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The Magazine may also be purchased from THE METEOROLOGICAL OFFICE, SOUTH KENSINGTON, LONDON, S.W.7.

On Keeping Touch with the Weather of the World

AN eloquent appeal has been issued recently as a circular letter, dated July 10th, 1924, by Mr. Sampaio Ferraz, Director of the Brazilian Meteorological Service, for the inclusion in a single monthly publication of particulars of anomalous weather in all parts of the world. He points out that " this would encourage anyone interested in the subject to pursue further studies leading to a better comprehension of variations in general circulation and to more enlightened weather correlation work." " We here in Brazil have noted " he says, " that April and May last have run with very abnormal circulation and excessive rains, and hear that similar facts have been observed in other parts of the world. Would it not be valuable to have official reports from all the organized services, chiefly those that draw up daily charts, published in some meteorological review or magazine, so that one could in a glance, obtain a general appreciation of such anomalies as seem to occur this year in a striking manner ? "

Since the inauguration of the *Meteorological Magazine* (as distinct from *Symons's Meteorological Magazine*), it has been the rule to devote a page or more each month to weather abroad. The material for these pages has been derived in part from official reports, such as those which are transmitted to their London representatives by the Governments of India and Australia, but mainly from the descriptions of striking weather in the newspapers. In the selection of items of news, regard has been paid mainly to the obvious manifestations of the weather rather than to such matters as the distribution of pressure, of interest

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mainly to the professional meteorologist. Mr. Ferraz's letter is evidence that there is a demand for the immediate publication of information as to these phenomena, less dramatic, but perhaps of more far-reaching importance, and we propose to devote more space to them in future. The information cannot be gathered, however, from the newspapers, and we must therefore ask for co-operation of meteorologists in other countries. The art of long-range forecasting is at present not very far developed, but it is clear that it must be based largely on the summarising of weather anomalies over large areas, and that the more up-to-date the information the better. Monthly summaries are now available in most coun ries within a day or two of the end of each month, and we should be glad if the more abnormal features of such summaries could be communicated to the Meteorological Office immediately for use in the article on " Weather Abroad " in this magazine. For this purpose the reports should be in the hands of the editor not later than the 10th day of the month following that to which they refer. From many countries, reports can be sent by post with the certainty that they will arrive in time. In other cases, communication by cable will be necessary. Mr. Ferraz has himself set the example by despatching a telegram monthly from Brazil. We do not suggest that similar messages should be sent to us from every country with the same regularity. The idea is that a report is desirable whenever the atmospheric conditions have been so abnormal as to command the attention of foreign meteorologists.

The Meteorological Office publishes already the *Réseau Mondial,* a collection of meteorological statistics month by month for all parts of the world. The first volume of the *Réseau Mondial,* that for 1911, was in preparation in 1914 ; the war delayed the publication of subsequent volumes, but great progress has been made of late : the volume for 1916 has just been issued, and it is hoped that two volumes will be published annually until the minimum lag, which can hardly be less than 12 months, is achieved.

The notes in the *Meteorological Magazine* will give early intimation of abnormalities which will be recorded in greater detail in the tables of the *Réseau Mondial.*

Staff News. The degree of Ph.D. has been conferred on S. N. Sen by the University of London for two theses, the main one on " The Design of the Kew Pattern Barometer " and the subsidiary one on " Surface and Geostrophic Wind Components at Deerness, Holyhead, Gt. Yarmouth and Scilly." The latter thesis will be published shortly as Geophysical Memoirs No. 25. This is the first time the degree of Ph.D. has been given to a meteorologist in this country.

Thunderstorms and Normal Atmospheric Electricity

By G. C. SIMPSON, F.R.S.

IN the *Meteorological Magazine* for October, 1924, Mr. F. J. W. Whipple develops C. T. R. Wilson's suggestion that the negative charge on the earth's surface is a by-product of the electrical processes which take place in thunderstorms. It is now generally known that in regions of fine weather the surface of the earth is negatively charged, and that this charge is constantly passing into the atmosphere. In other words in fine weather regions there is a constant flow of negative electricity from the earth's surface into the upper atmosphere.

The chief problem of atmospheric electricity is to find out how the earth receives the negative electricity to supply this constant loss. For many years the answer was that rain is negatively charged, and so the negative electricity is restored in regions of rainfall. This simple explanation received its deathblow when actual measurements in widely separated regions of the earth's surface showed that rain brings down more positive than negative electricity. When this result became generally accepted, many able physicists attacked the problem again, but no one found a solution based on the known properties of electricity. The only suggestions which survived depended on some form of very penetrating rays—of the nature either of X rays or cathode rays—but no rays having the characteristics required are known definitely to exist. It therefore caused considerable surprise when Mr. C. T. R. Wilson in his important paper on "Investigations on lightning discharges and on the electric field of thunderstorms,"* made the suggestion referred to above. It is with the object of pointing out some of the difficulties of this suggestion that this short note is being written.

In the first place, it must be clearly understood that we are dealing only with a suggestion—a hypothesis. Wilson does not sketch out any mechanism of a thunderstorm which would result in the effect he supposes, nor does he give any experimental or observational evidence that such a process exists. He simply says, "If any considerable proportion of shower clouds are of positive polarity the upper atmosphere will receive an excess of positive electricity which may possibly be sufficient . . . . to supply the normal downward current of the fine weather regions"; surely a sufficiently guarded sentence.

Now let us examine what conditions must be fulfilled if the suggestion is correct. The earth's surface can be divided into two parts: (*a*) regions of fine weather, (*b*) regions of precipitation. The surface in (*a*) loses negative electricity all the time, therefore,

* *London, Phil. Trans. R. Soc.*, Vol. 221 A. 1920, p. 73.

if C. T. R. Wilson's theory is correct, the surface in (*b*) must on the whole either receive negative electricity or lose positive electricity. We know, however, that the surface in (*b*) actually receives positive electricity from the precipitation; this only makes the difficulty greater, for we have got to get rid of this electricity also.

The only solution would appear to lie in the electrical currents to which the large electrical fields associated with precipitation, especially in thunderstorms, give rise. These high fields set up something of the nature of brush discharges from all points exposed to the free atmosphere. Now, in a thunderstorm the electrical field at the earth's surface undergoes very rapid changes. Up to the present we have not sufficient measurements of these high fields to determine whether the positive or the negative fields are the greater. We do know, however, that positive fields are much more effective in dragging negative electricity out of the surface of the earth, than negative fields are in dragging out positive electricity. Unfortunately, however, this is in the wrong direction for the success of the theory. This difficulty might be overcome if the negative fields were much stronger than the positive fields, but as has already been stated we have no evidence that they are. If negative fields exist longer than the positive fields the difficulty might be surmounted and at first sight this seems to offer a loop-hole, for we do know from observation that negative potential gradient is more frequent than positive during precipitation. It must, however, be remembered that we are only concerned with high fields, and we know that most of the negative potential gradient during precipitation is very weak. We certainly do not know that high negative fields exist longer than high positive fields.

Space does not allow a more detailed discussion, but perhaps enough has been said to guard readers against imagining that the main problem of atmospheric electricity has been solved. More and more observations are required and they are being slowly accumulated. In the meantime suggestive articles like that of Mr. Whipple are very valuable.

Official Publication

The following publication has recently been issued :—

PROFESSIONAL NOTES—

No. 37. *Pressure Type in relation to Fog Frequency at Scilly during Summer Months.* By E. G. Bilham, B.Sc., D.I.C. (M.O. 245q.)

Although the general conditions suitable for the formation of fog at sea are generally well-known, viz. : warm, damp air blowing over colder water, yet the forecasting of sea-fog is notoriously

difficult. As a part of a wider investigation, Mr. Bilham has determined the frequency of occurrence of fog in the Scilly Isles, with different distributions of pressure in the neighbourhood of the British Isles. He found that sea fog is most likely when pressure is rather high over England and the North Sea, and there is a gentle flow of air towards Scilly from the Bay of Biscay. In such circumstances the odds against fog in 24 hours are as low as 7 to 5. On the other hand, in the 14 years covered by the investigation, sea-fog never occurred at Scilly in the summer months either in the northerly current on the flank of a V-shaped depression or in the easterly current blowing from central Europe. It may be noted that in the former case there would be cold air blowing over warmer water, in the latter case the warm air would be too dry to produce fog even though it was in contact with colder water.

Discussions at the Meteorological Office

November 10th, 1924. *Die thermische Schichtung der Atmosphäre.* By W. PEPPLER (Beitr. Phys. Atmos. XI., p. 79). *Opener*—Mr. E. V. Newnham, B.Sc.

The author of this paper has tabulated the isothermal layers or inversions of temperature obtained in 6,000 ascents made at Lindenberg during 1910 to 1916, and worked out their frequency in each stratum of 200 metres thickness in each month and in each season. The highest frequency is observed at all times in the lowest stratum : above 4,000 metres inversions or isothermal layers are rare. Large inversions above the level of 900 metres are most common in April and the autumn. These results are discussed and explanations of them attempted. Dynamical warming of the air by descent is thought to be the chief cause of inversions, but explanations involving the horizontal motions are invoked to explain the April and autumn maxima. It was pointed out in the discussion that statistical methods were not entirely satisfactory for dealing with upper air results, as such methods included under one head a variety of causes and effects, and the opinion was expressed that explanations of inversions could be arrived at only by the examination of each inversion in the light of the synoptic chart.

November 24th, 1924. *Investigation of the Dust Content of the Atmosphere.* By H. H. Kimball and I. F. Hand (Washington M.W. Rev., Vol. 52, March, 1924, p. 133). *Opener*—W. H. Pick, B.Sc.

One of the steps taken by the International Union for Geodesy and Geophysics at the Meeting at Rome in 1922 was to authorize the purchase of some of the instruments designed by Dr. Owens

for the collection of samples of atmospheric dust. These instruments were to be issued to meteorological institutes in various parts of the world so as to stimulate enquiry. The first-fruits of this wise action are to be found in Dr. Kimball's report on observations near the ground and at various heights reached by aeroplanes in the neighbourhood of Washington. The technical difficulties found in manipulating the apparatus in an aeroplane appear to have been satisfactorily overcome. Of the results which are reported, we may mention two: (*a*) The number of dust particles is of the same order at heights up to 6,000 ft.; above that height the number generally falls off rather rapidly. (*b*) Near the ground the number of particles is lower in the afternoon than in the morning, but at 2,000 ft. and upwards the number of particles increases, if anything, in the afternoon.

The discussion brought out the reluctance of meteorologists to accept the doctrine that haze in English country districts is mostly smoke from the towns. Dr. Owens gave evidence, however, that the dirt-producing haze on the east coast was smoke from the other side of the North Sea. The relation between Aitken nuclei and the dust revealed under the microscope on Dr. Owens's slides was also discussed. Aitken himself believed that opacity of the atmosphere could be produced by the condensation of water on nuclei, even when the humidity was far below saturation. No recent evidence for this hypothesis is available. The hope was expressed that it would be investigated again with the aid of both Owens's and Aitken's counters.

THE subject for discussion on January 19th, 1925, will be a paper by E. Gherzi, entitled: *Étude sur les microseismes* (Observatoire de Zi-ka-wei). *Opener*—Capt. H. W. L. Absalom.

Royal Meteorological Society

AMONGST the meetings of the month, pride of place must be given to the joint meeting of the Physical Society of London and the Royal Meteorological Society. It is the first time the latter Society has participated in a joint meeting with another society, and the Council may be congratulated on the success of the innovation. The meeting was held on November 28th at the Imperial College of Science, Mr. F. E. Smith, President of the Physical Society, being in the chair. The discussion, which was devoted to Ionization in the Atmosphere and covered a wide range, was opened by Dr. Eccles with an historical résumé. Dr. Chree dealt with the variations in ionization near the ground. He appealed most strongly to his audience when he deplored the loss which science had suffered by Lord Kelvin having to spend his life as a University Professor instead of as Head of a Geophysical Observatory. Dr. Appleton gave an account of

geophysical influences on the transmission of wireless waves, and pointed out how the establishment of broadcasting stations had provided opportunity for the repetition of experiments which in the early days of wireless telegraphy required careful organization. Mr. Watson Watt told of the development of the investigation of "atmospherics," and gave reasons for the belief that all atmospherics are produced by distant lightning. Mr. C. T. R. Wilson followed with theories as to the ionization produced by thunderstorms. He did not devote much time to the question how the charges are produced which are dissipated in the lightning flash, but developed a new hypothesis according to which the electrostatic field due to an electrified cloud may be strong enough to produce ionization of the rarified air in the region 50 kilometres or more above the clouds. He challenged Dr. Simpson to deny the existence of clouds of positive polarity (with + charges at the top, and — charges below). This challenge was duly accepted by Dr. Simpson a few minutes later. The last paper, by Professor S. Chapman, on the evidence of terrestrial magnetism for the existence of highly ionized regions in the upper atmosphere was interesting to meteorologists as showing how the discussion of the atmospheric tides produced by the sun and moon is a necessary preliminary to the theory of the daily movement of the magnetic needle. The electric currents in the high atmosphere are governed on the one hand by these tides, and on the other hand by the development of ionization at various levels.

THE monthly meeting of the Society was held on Wednesday, November 19th, at 49, Cromwell Road, South Kensington, Capt. C. J. P. Cave, President, in the Chair. The following papers were read:—

Sir Gilbert Walker, F.R.S.—Note on Bjerknes's Contribution of 1921 *to the Mechanics of the General Circulation.*

W. H. Dines, F.R.S.—The Correlation between Pressure and Temperature in the upper air, with a suggested explanation.

Correspondence

To the Editor, *The Meteorological Magazine*

Precision in Rainfall Measurement

REFERRING to Mr. M. J. Salter's letters* on the above subject, I fear the average observer would not take the trouble to adopt either of his plans for obtaining precise small measurements of rainfall. Since reading his first letter and your comment thereon,

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**Vide Meteorological Magazine, Vol.* 59, 1924, *p.* 210 *and p.*239.

however, I have experimented with having two glass-bottle receptacles for my 5 in. "Snowdon," instead of only one, and had already been using a plan similar to Mr. Salter's second one, which I have found most satisfactory. Apart from the accuracy obtained for small amounts, the fact of having another receptacle ready to replace the one in use is most convenient when rain is falling at the time of observation, and I am sure that, for this reason alone, Mr. Salter deserves the thanks of the large army of observers reporting to the British Rainfall Organization.

D. W. HORNER.

47, *Forest Road, Tunbridge Wells, November 19th*, 1924.

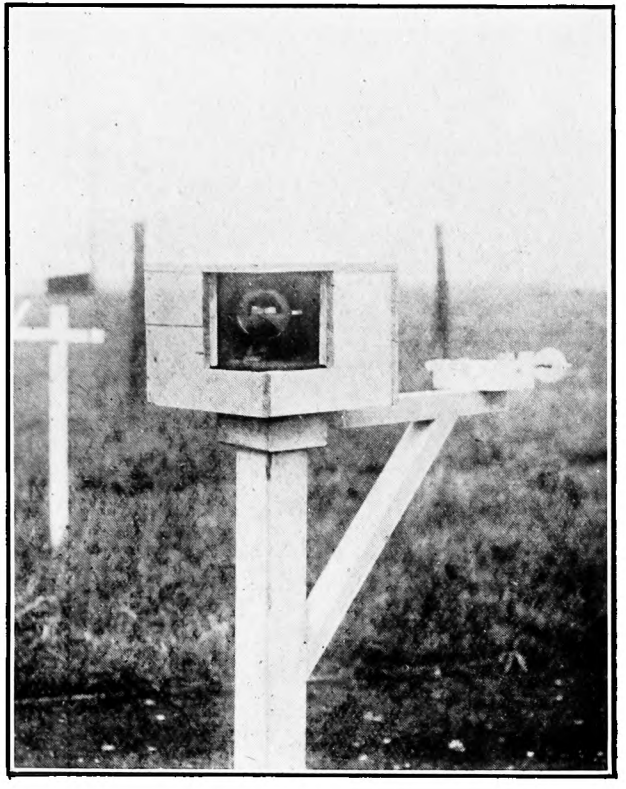
A Roof for the Campbell-Stokes Sunshine Recorder

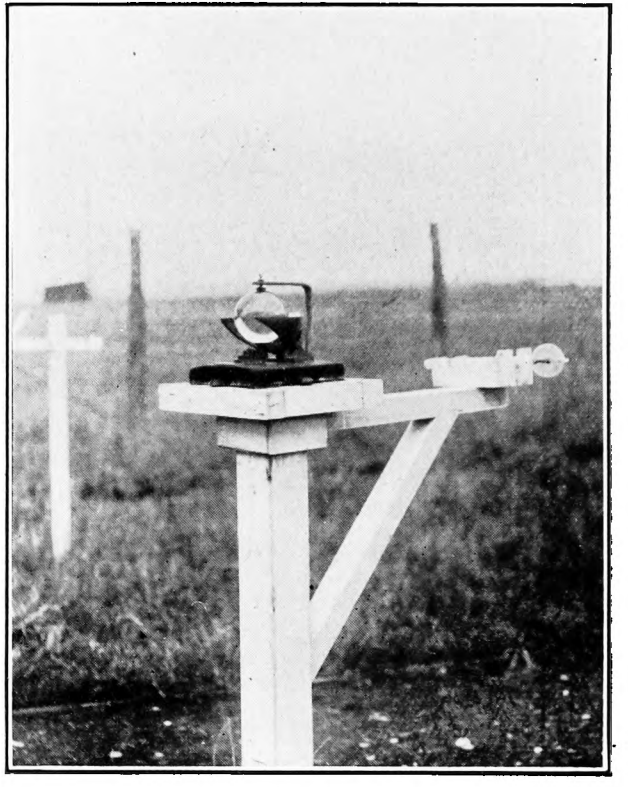
THE deposition of hoar frost on the glass sphere of the Campbell-Stokes Sunshine Recorder during winter nights is frequently sufficient to cause the loss of an hour's trace the following morning. The instructions in the *Observer's Handbook*, state that if snow or hoar frost settles on the recorder, it should be removed at once, and at some observatories it is the rule for an observer to remove the hoar frost at sunrise, but this is not always practicable. The question assumed importance at Porton, where in the course of a certain investigation it became necessary to know whether the absence of sunshine trace in the early morning was due to a clouded sky or to a coating of hoar frost on the glass sphere. It was therefore decided to try to devise a cover for the sunshine recorder which would prevent the formation of hoar frost on the instrument, and yet enable it to receive early morning sunshine. The device, which was employed all last winter, consisted of an inverted box with the sides cut away at the south-east angle. The two photographs show the sunshine recorder with, and without, this cover in position. The cover, which is used only during the winter months from October 1st to March 31st, is put over the recorder after sunset and removed at some convenient time in the morning.

It is not possible to state numerically the advantage gained by this means, because there is no other sunshine recorder sufficiently near to permit a comparison being made, but it is believed that this cover is fairly effective, although after nights of very heavy frost the exposed face of the glass sphere was sometimes found to be frosted. It is not claimed that the cover in its present form is the best that can be devised, and the idea is put forward in the hope that somebody, with two recorders at his disposal, may be induced to carry out an investigation.

N. K. JOHNSON.

Meteorological Dept., Experimental Station, Porton, November 14th, 1924.





THE CAMPBELL-STOKES SUNSHINE RECORDER AT PORTON
ROOFED AND UNROOFED

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ELLIPTICAL LUNAR CORONA OBSERVED AT ABERDEEN, OCTOBER 11TH, 1924

An Elliptical Lunar Corona at Aberdeen

A lunar corona of elliptical form was observed here at 19h. 30m. G.M.T. on October 11th, and remained visible unchanged for a period of about twenty minutes. The phenomenon consisted of an elliptical ring eccentric about the moon. The colours were distinctly marked, and gradated from a warm creamy glow near the moon through lemon-yellow to the orange-red-brown of the ring. The upper half of the ellipse was bounded by a band of violet light of a very pure colour. This band, thin at the top, widened at the sides of the ring. Above this came a broader arc of light of a tint resembling "electric-blue," but of a less pronounced brilliance than the violet band. Next this, a band of dull olive-green formed the outer top edge of the display. All three bands terminated at the sides about level with the horizontal diameter of the ellipse. The sky round the moon was covered with a coarse streaky type of cirro-stratus; wisps of fracto-stratus were seen at times.

The corona became irregular by 20h., but later assumed the usual circular form, showing a faint tint of cream colour with very little, if any, indication of the brownish red ring. Afterwards the corona disappeared, and a lunar halo formed. The sketch*, although accurate in form, lacks the necessary luminosity.

The principal dimensions were obtained by estimation in terms of the apparent diameter of the moon and were as follows:—

Bottom of moon to lower edge of ellipse ..	about	3 diameters.
Top of moon to upper edge of ellipse ..	,,	5 ,,
Horizontal diameter of ellipse between outer edges	,,	12 ,,
Distance between outer edges of violet arc	,,	16 ,,
Vertical width of electric blue band ..	,,	3 ,,
Vertical width of green band	,,	1 diameter
Elevation of moon	,,	30 degrees.

Unfortunately, I was the only member of the staff to notice the earlier corona, although I have since then heard several comments from the general public on the extraordinary colours shown.

P. F. JARROLD.

The Observatory, King's College, Aberdeen, October 27th, 1924.

The Great Snow Storm in Cornwall

IN our local daily paper, the *Western Morning News and Mercury*, we have a weekly article on "Antiquarian Lore in the West," edited by an excellent authority. In to-day's issue, we have undoubted evidence of a heavy snow-fall in west Cornwall in December, 1630.

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* Mr. Jarrold's sketch is coloured. We regret that it has only been possible to reproduce it in black and white.

In the Phillack Parish Register of Burials, is recorded the burial of three persons on December 11th, and one on the 12th, 1630, and opposite their four names is the note "Died in the snow." In the Breage Register, is a similar record, namely one on the 11th, two on the 12th, and one on the 19th of December, 1630, with the note "*Hi quatuor perierunt in nive.*" The small town of Hayle, between Penzance and Cambourne, is in Phillack Parish, and Breage is 7 miles to the south-east and 3 miles west-north-west of Helston.

Apparently, the fall must have been very heavy and lasted several days, as it would appear that the body buried on the 19th was not found for several days: on the other hand he may have been found alive and died later from the effects.

CHAMBRÉ C. VIGURS.

Newquay, Cornwall, November 17th, 1924.

NOTES AND QUERIES

The Laboratory at the Meteorological Office, South Kensington

WHEN the Meteorological Office moved from Victoria Street to South Kensington in 1910, it found itself equipped for the first time with a laboratory in which the apparatus and instruments used in meteorology could be tested and in which experiments could be made with a view to effecting improvement in all the material used in meteorological work. After the British Rainfall Organization was absorbed in the Meteorological Office, it became necessary for full provision to be made for the testing of measuring glasses for rainfall. The apparatus shown in the illustration has been specially designed for this purpose. It will be seen that the precise amount of water corresponding with each graduation can be delivered into a measure from the appropriate burette. Four burettes are provided to allow for graduations in inches and millimetres of the measures for 5 inch and 8 inch gauges.

Some other additions necessary for experimental work and for the examination of the peculiarities of instruments as well as for testing them have recently been made; among these are a pressure chamber large enough to hold an ordinary barograph (or a number of aneroid barometers and meteorographs) for calibration against a standard mercury barometer; a sensitive micromanometer, which is used primarily for testing pressure tube anemometers; and horizontal and vertical collimators for the testing of theodolites. Facilities are also available for the testing of pilot balloons and the clocks used in recording instruments.

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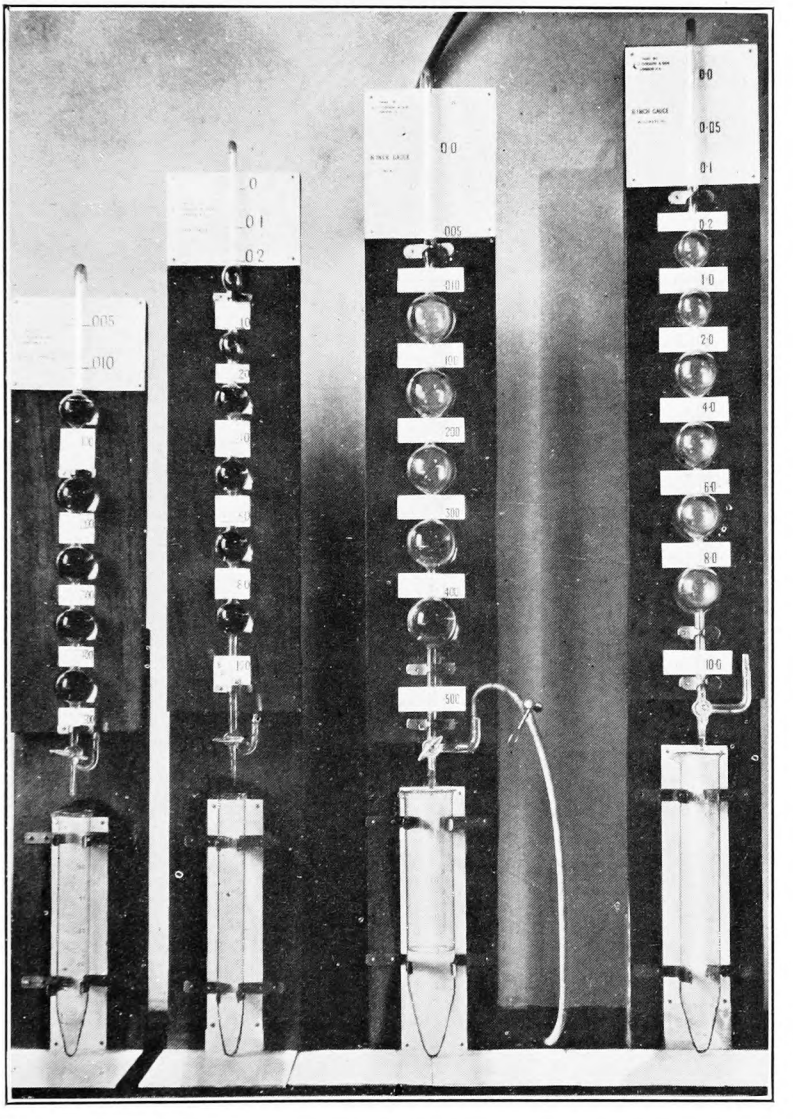

APPARATUS FOR TESTING RAINGAUGE MEASURES AT THE METEOROLOGICAL OFFICE, SOUTH KENSINGTON

Sir Oliver Lodge's Views on Electrical Precipitation

ON October 29th, Sir Oliver Lodge delivered a lecture before the Institute of Physics, on "Electrical Precipitation." Electrical precipitation is now adopted on a large scale for extracting the suspended solids from flue gases: this is not only useful as a means of keeping the air from being fouled, but in many metallurgical processes, the material which is recovered is of great value. Moreover, the clean gases are more efficient for heating boilers, etc., than smoky gases would be. The lecturer dealt also with the part played by electrical forces in the production of rain. In his view, the coalescence of the small droplets which predominate in clouds, into the large drops which fall as rain, is due to the electrical charges carried by the droplets. The early experiments which he described lend considerable support to this theory.

At the end of his lecture, Sir Oliver discussed how man would set about the production of rain artificially. We quote his peroration: "There are difficulties about the electrical controlling of the atmosphere. Is that to be the one region of the earth over which man has no power, and about which he must succumb supinely to fate? I do not believe that it is. I feel sure that if the control of the atmosphere is felt to be an important problem, it will be tackled either now or by posterity. The considerations to which I have called attention in this lecture are such as to give some kind of clue, perhaps only the inkling of an idea. There are meteorologists who know far more about the atmosphere than I do. They will, I expect, be conservative in their estimate. It may be that physicists rush in where meteorologists fear to tread! But, anyhow, the problem strikes me as no more difficult than the problem of disease at one time appeared, and I venture to regard the future with some hope."

The British Rainfall Organization in the service of Water Engineers

Two papers dealing with rainfall were on the programme of the Annual Meeting of the Institution of Water Engineers, held on December 4th, 1924. A posthumous paper by the late M. de C. S. Salter was devoted to the construction of a rainfall map of the British Isles on the scale 2 miles to the inch. Isohyets showing the annual rainfall have been drawn on this scale for more than half of the country, and, as Mr. Whipple mentioned in the discussion, the work is proceeding steadily. Two maps reproduced in Mr. Salter's paper illustrate the technique of rainfall mapping, one showing how over-exposure of rain-gauges to the wind must be allowed for, the other indicating that even a

hilly area (the Trossachs) can be mapped with comparatively few observations, so that when more observations are available they fall into place. Stress is laid, however, on the desirability of numerous accurate records as the best safeguard against error.

The second paper, "Fluctuations of Annual Rainfall: three driest consecutive years," was by Mr. J. Glasspoole. In water-works practice it is common to provide reservoirs on the assumption that the water available each year will be 80 per cent. of the average rainfall, minus an allowance for evaporation. It seems that the fraction 80 per cent. was adopted originally on the ground that a certain amount of storm water would be unsuitable for storage. Another reason was found by Sir Alexander Binnie, who pointed out that the average rainfall of three driest consecutive years was about 80 per cent. of the normal rainfall. A water conservation scheme must provide enough water for its clients in a run of dry years. It is unprofitable to enlarge the reservoirs of a restricted gathering ground if enough water to fill them is not to be expected in dry years. The better policy is to utilise additional gathering grounds. Mr. Glasspoole's paper is concerned with the question whether the fraction 80 per cent. is appropriate for all parts of the British Isles. He finds that in the north-west of Ireland the rainfall is so reliable that more than 90 per cent. of the normal can be anticipated in the three driest consecutive years. On the other hand, in a few parts of England and Scotland there is a slight risk of less than 80 per cent. occurring. The paper serves incidentally as an index showing, for each part of the country, which were the three driest consecutive years.

The Great Dew Pond Myth

UNDER this forceful title, Mr. Eric W. Walford has written for the October number of *Discovery* a discussion of the nature of the hillponds of the south of England. The work of Mr. E. A. Martin on the subject is clearly summarised, but we should have liked to see a reference to Martin's book.

There are two details which call for comment. Martin came to the conclusion that the dew ponds in some way collected a deposit which was not rain. It appears, however, that he did not realise the difficulty in measuring rainfall on the open downs. "In one month," he writes,* "from August 25th to September 24th, 1908, there fell into a rain-gauge placed outside the bank of my experimental pond 2·11 in. In a rain-gauge placed in the centre, on the bottom of the depression there fell in the same period 2·98 in." Nowadays, we should explain the discrepancy by saying that the gauge outside the bank was catching the wind too much, so that the eddies whirled the rain away and that the

* E. A. MARTIN. *Dew Ponds: History, Observation and Experiment.*

gauge in the middle of the pond gave the true rainfall. Similarly when Martin records that the pond rose ¼-in. when the rainfall was ·11 in., we suspect that ·25 in. would have been a better estimate of the rainfall.

The other point is that Martin, and Walford follows him, refers to the mists on the Downs as sea mists. This name is surely very misleading. The mists formed on the hill-tops when the wind is blowing off the sea, represent either the low clouds from over the sea, or clouds formed in the air as it rises to pass over the hills. The production of drizzle in such rising air is no doubt the source of much of the precipitation in the so-called dew ponds. There is evidence that in some cases the drippings from bushes add appreciably to the water in the ponds, but the ponds without bushes are equally successful in retaining water throughout the year. It is, therefore, desirable to lay stress on the drizzle and rain as the principal source of supply.

Dramatic Weather in the United States: June, 1924

THE *Monthly Weather Review* for June, 1924, contains vivid descriptions of two remarkable incidents.

1. On June 28th, there was a very destructive tornado, the track of which passed across the southern tip of Lake Erie. A 95-foot gasoline yacht, *Oswichee*, encountered the storm. Dr. M. L. Combes who was on the boat, writes, "The fury lasted for 20 minutes with continuous streak lightning: the roar was so great that we could not hear the thunder. Then the waterspout went across our stern, drenching us with water, followed by a heavy spray and a very decided suction which lifted the pipe from our furnace . . . . It also pulled up the canvas which covered the top deck and was nailed round the edges." Eighty-three people lost their lives through this tornado, the majority where it left the lake at Lorain, Ohio.

2. On June 13th, unprecedented rain occurred in Carter County, Tennessee. The highest reading of a rain-gauge was 11·24 in., but water to the depth of nearly 15 in. was found in a "stone crock," at Cardens Bluff. It is reckoned that at least 12 in. out of the 15 must have fallen in 3⅛ hours. There are indications that at times the rainfall was much more intense than these figures would suggest. "Those who saw the storm say that not only was there a most intense general rain over the region, but that at many places the clouds broke as if punctured and discharged perfect streams of water. The truth of this statement is shown by deep gashes or scars, almost resembling cuts from a hydraulic jet that were cut into the hillsides at places where there had been no depression or watercourse." In a small ravine at Cardens Bluff, two houses were demolished,

and nine of the occupants drowned. The catchment area of the ravine does not exceed 15 acres. "One of the inhabitants who escaped, stated that a wall of water, rock and earth 8 to 10 feet in height crashed into the houses without perceptible warning, totally wrecking them. He himself was thrown 30 ft. or more by the force of the blow and was severely injured." It is interesting to compare the photographs showing the "cuts from a hydraulic jet," with those obtained by Mr. Dansey* in the Black Mountains in Wales after a similar downpour there in 1907.

The Austrian Daily Weather Report

IN the Austrian daily weather report (Wetterbericht der Zentralanstalt für Meteorologie und Geodynamik in Wien), a chart is now being devoted to stream lines and rain areas. The innovation adds to the interest of the reports as the association of rainfall with converging winds is continually brought to mind. For example: in the chart for August 31st, 1924, a south-westerly air-stream is seen to be traversing France and impinges upon a south-easterly stream which extends from Central Europe to Iceland and Norway. A large rain area is shown, the centre of which lies near the line of discontinuity separating the two currents.

It seems an excellent plan to draw attention to the principal air-streams in this way, but in the reports under consideration there is sometimes an apparent discrepancy between the stream-lines and the actual surface winds; thus, on August 24th, there is a stream line indicating that a branch of a south-westerly current was following the Baltic coast and passing to the north-west of a centre of low pressure. The arrow showing a south-westerly current over Germany was in this case carried a little too far. Other discrepancies of this kind are to be observed occasionally, but in general there is good agreement.

A Chronicle of Catastrophes

A NEW journal, *Matériaux pour l'étude des Calamités*," owes its existence to the appeal of Senor Giovanni Ciraolo, President of the Italian Red Cross Society. It is published in Geneva by the local Geographical Society for the International Red Cross Organization. The two numbers of the journal which have appeared contain useful papers on such subjects as landslides (to which Italy is particularly subject), and locusts (a plague

* *British Rainfall*, 1907. p. 33.

which is being grappled with already on international lines). The journal contains chronicles of the catastrophes occurring in all parts of the globe. The chronicle in the first number covered the whole of the year 1923, but in the second number only one quarter, (July to September, 1924), is reviewed and the information is much more detailed. The first two sections of the later chronicle are devoted to earthquakes and volcanic eruptions, the last one to locusts, but all the catastrophes in the nine intermediate pages are attributed directly or indirectly to the weather, the headings being landslides ; floods ; tornadoes ; cyclones and hurricanes ; droughts ; famines ; fires (mostly forest fires). The chronicle promises to be very useful for reference.

The South African Irrigation Department Magazine

WE learn with great regret that the publication of the *Magazine*, issued by the South African Irrigation Department, is likely to be discontinued after the next issue. The *Magazine* has appeared quarterly for three years. The last number, that for September 1924, contains many interesting articles, amongst them a description of the Pretoria hailstorm of December 25th, 1923, by Mr. G. W. Cox. This thunderstorm was remarkable for the damage done by hail ; some effective photographs are reproduced, one shows a large hole pierced through a sheet of galvanised iron.

The British Antarctic Expedition

FOR the publication of the scientific results of Scott's last expedition, a sum was allotted from the fund raised by public subscription in 1913. The biological reports have been published by the Trustees of the British Museum, the physical by a publication Committee with Colonel H. G. Lyons as Honorary Editor. These physical reports were written by Dr. Simpson, Dr. Chree, Professor Griffith Taylor, C. S. Wright, R. E. Priestly and F. Debenham, all, with the exception of Dr. Chree, members of the expedition. The " Miscellaneous Data," which remained for publication have been collected by Colonel Lyons. They include details of the equipment of the expedition and should be of the greatest value to anyone organising another attack on the Antarctic continent. Some of the notes are of more general interest. Thus, we learn that goggles should be designed with adequate ventilation : otherwise dew and hoar frost condense on the glasses when the wearer is exerting himself and perspiring. None of the compositions for preventing deposition of dew on glass was found to be of any service. Again, " a depressing

effect was often caused by the almost total diffusion of the light, the clouded sky and the snow surface appearing of equal colour and light intensity, so that the two, and the horizon between, were indistinguishable from one another. The result was that there was often complete loss of contrast. No shadow was cast and the horizon blended with the dead white of the Barrier surface. One could stand almost alongside a cairn, nine feet high, and be unable to see it. No shadow being cast, one was quite unable to distinguish *sastrugi* or any snow projections on the surface before falling over them. Often on the better days, after sighting a cairn a quarter of a mile away, a stumble would cause it to be lost ; after searching for long periods, one would realise that, in the endeavour to pick up the cairn, a false horizon was being searched."

Mr. C. S. Wright contributes a discussion of the merits of sledges of different types ; the sledge which is made with narrow runners for travelling on hard ice will not serve for tracking over soft snow, and where a variety of conditions may be met with it is good policy to prepare for the worst. Quite apart from any question of the hardness of the snow, however, the surface temperature has an important influence. In man-hauling sledges, it was found that the friction decreased steadily as the temperature rose, the presence of brilliant sunshine having an effect which was more than a psychological one on the speed of advance. Below zero Fahrenheit friction seemed to increase progressively as the temperature fell, as if a greater and greater proportion of the friction were due to relative movement between the snow grains and less to sliding friction between runner and snow. It was found that sledging, even in moderately hard snow, involved daily exertion not less than that corresponding to pulling a load of 250 lb. per man up a glacier of bare ice 3,000 feet high, the distance of travel being the same in each case.

Colonel Lyons and his Committee are to be congratulated on the conclusion of a great work, a worthy memorial of the British Antarctic Expedition.

Popular Meteorology in France

AN up-to-date little book, " L'Atmosphère et la Prévision du Temps," by Prof. J. Rouch, has recently been published as one of a series of the " Collection Armand Colin (section de physique)." In the first part of the book the methods of observation of temperature, pressure, winds, &c., are described. There follows a description of the distribution of the elements over the globe and their local variations. The last part of the book is devoted to forecasting both for long and short periods, and the uses of meteorology in connection with agriculture and war.

The author has been very successful in compressing much information into a small compass. He has been careful to omit superfluous detail from his diagrams; perhaps, in some instances, this economy has been carried too far, as in the maps (pp. 95, 98) showing by means of shading the areas of highest and lowest pressure for January and July. In these maps there is no standard value beyond which an area is designated high or low; for example, over Siberia, pressure has to reach 775 mm. before it is included in a high, and over the Pacific or Atlantic only 767 or 766 mm. It is difficult to see what has been gained by this lack of consistency. The allusions in the chapter on the application of meteorology to military arts makes us wish that the author would give us a fuller account of meteorology in the Great War. How many of us know of the squall of May 5th, 1916, which carried away 20 captive balloons on the Western Front? It is interesting to learn that the naval gunner is as anxious as the military to utilise the results of pilot balloon observations, and that the meteorologist is able to meet the demand "Pour les altitudes supérieures, on a recours au sondage aérologique par ballon-pilote, pas plus difficile à exécuter à bord qu'à terre." Every reader will agree that the book is worthy of the motto of the series: "Vulgariser sans abaisser."

The Light of the Night Sky

THE background from which the stars stand out on a clear night is not mere darkness. See how the sky contrasts with the branches of the trees when you travel along a shady road by starlight. In recent years Lord Rayleigh has shown that an important component of the light of the night sky in all latitudes is the green auroral light. He has now* devised apparatus by which visual observations of the intensity of the light can be made. He uses as a standard the phosphorescence produced in potassium uranyl sulphate by radium, and by the aid of suitable filters he isolates not only the green but also the red and blue components of the sky light. Remarkable variations in the intensities of the components are found; these variations are comparatively slow; there is close agreement between observations on consecutive nights, but the light changes its character from month to month. It is not blue like the light of the day sky, in fact the observations with the light filters suggest that the night sky may be as yellow as the light from an ordinary metal-filament glow lamp. Of course the unaided eye can not appreciate the colour of such faint light. Lord Rayleigh con-

* The Light of the Night Sky: Its Intensity Variations when Analysed by Colour Filters. By Lord Rayleigh. *London, Proc. Roy. Soc. A*, Vol. cvi., 1924, p. 117.

siders that the illumination of the night sky can not be due to diffuse sunlight, he would explain it as a phosphorescent glow excited in the upper air during the day and persisting during the night. As the apparatus described by Lord Rayleigh is simple it may be anticipated that observations will be made at numerous stations in all latitudes. There is an opening for good work by amateur meteorologists.

Reviews

West Indian Hurricanes and other Tropical Cyclones of the North Atlantic Ocean. By Charles L. Mitchell. Monthly Weather Review Supplement, No. 24. Size $12\frac{1}{4} \times 9\frac{3}{4}$, pp. iii. + 47. *Illus.* Washington, 1924.

Mr. C. L. Mitchell, who is one of the forecasters of the Washington Weather Bureau, formed some time ago the opinion that no storms ever originate in the eastern two-thirds of the Caribbean Sea (east of 78° W). To test this view he considered all the West Indian hurricanes, the tracks of which had been drawn in earlier publications as though the storms had originated in this area. Using more material than had been employed formerly, he re-drew the tracks, and substantiated his opinion. He was led on to the preparation of a valuable publication, which must rank as the most comprehensive and up-to-date work on the general characteristics of the tropical cyclones of the North Atlantic. Charts are shown giving the tracks of numerous storms in the different months, and many individual storms are described in detail. It is interesting to note the large number of storms that pass across the Atlantic to north-west Europe between August and October, and the rarity of this phenomenon in June and July. These cyclones are, of course, indistinguishable from ordinary temperate cyclones long before they reach European waters.

E. V. NEWNHAM.

News in Brief

A lecture on "Thunderstorms," was delivered before the Royal Aeronautical Society by Dr. G. C. Simpson, F.R.S., on Thursday evening, November 27th.

NEWS has lately been received that Amundsen's ship, the Maud, has been compelled to give up the attempt to drift across the North Pole. Captain Amundsen left Norway in the Maud in June, 1918, intending to enter the pack ice off the New Siberian Islands, but it was not until 1922, after Amundsen had left the ship to attempt the flight across the North Pole, that the Maud became frozen in the pack ice to the north of Point Hope,

and began to drift. The progress of the drift has since from time to time been reported by wireless, and from December, 1922, weather messages have been transmitted which have helped to complete the circle of observations round the northern hemisphere.

The Weather of November, 1924

CLOUDY weather, two short cold spells, rainfall below normal in the northern districts, and a remarkable gale in the south were the most noteworthy features of November. During the first two days unsettled weather prevailed, with strong winds and gales (force 10 (60 m.p.h.) at St. Ann's Head at 13h. on the 2nd) along the south-west coasts and heavy rain in the south; 46 mm. (1·80 in.) being recorded at Tynywaun (Glamorgan), 41 mm. (1·60 in.) at Brushford (Somerset), and 40 mm. (1·57 in.) at Holne (Devon). Floods occurred in the neighbourhood of Exeter and in the Thames Valley. In the rear of this depression an anticyclone passed slowly eastwards across the British Isles, causing quiet fair conditions with much local mist and fog. Northerly winds prevailed at first and were associated with slight showers of hail or snow in a few places and a drop in temperature which spread gradually southwards on the 3rd and 4th. Severe frost occurred inland on the mornings of the 4th, 5th and 6th, a "grass minimum" temperature of 10° F. being recorded at West Linton on the 6th, and of 11° F. at Rhayader (Radnor) on the 5th. From the 9th to the 11th the winds were southerly and the weather mild, with rain in the west. On the 12th a secondary depression developed and crossed southern England, causing heavy rain locally, 30 mm. (1·18 in.) fell at Shoeburyness. It is noteworthy that the approach of this depression was accompanied by a general increase of pressure, and that barometer readings near its centre were about 1025 mb. Further depressions over the northern Atlantic caused a continuance of the unsettled weather in the extreme west and north until the end of the month, but under the influence of an anticyclone, which spread south-westwards from southern Scandinavia, quiet fair weather prevailed in the south for nearly a week. With the clearer skies and a steady flow of air from the Continent there was a pronounced fall of temperature. Screen minimum readings were as low as 20° F. or 21° F. in some districts on the 17th and 18th, and day temperatures also did not reach 40° F. at several stations on those two days. Much local morning fog and midday sunshine were associated with the frost. During the last ten days depressions from the Atlantic spread again over the whole of the kingdom, causing strong winds and frequent rain, which was heavy locally, *e.g.*, 85 mm. (3·35 in.) were reported from

Dungeon Ghyll and 50 mm. (1·97 in.) from Sedbergh (Yorks) on the 22nd, 49 mm. (1·93 in.) from Aasleagh (Mayo) on the 24th, and 48 mm. (1·89 in.) from Watchet (Devon) on the 26th. The worst gales occurred on the night of the 26th-27th, when gusts of 72 m.p.h. were recorded. The secondary depression which gave rise to these gales was situated over the Bay of Biscay on the morning of the 26th, and, deepening rapidly, moved northwards to the Irish Sea by 7h. on the 27th. The area first affected by the disturbance was the English Channel and south-east England, where the wind rose rapidly to gale force in the early hours of the morning. Gales were first reported from S at 22h. on the 26th at Dungeness, from SSE at midnight at Portland Bill, and from SSE at 1h. on the 27th at Calshot. Later the affected area spread northwards, force 9 being reported from Gorleston at 5h., and force 10 from SSE from Spurn Head at 6h. At 7h. gales between SSE and SSW were general south-eastwards of a line from Spurn Head to Portland Bill. After this, though the area of strong winds continued to spread northwards, the force of the winds in the area was less, and the gales in the south began to subside. Pressure rose rapidly in the rear of the depression, and at 13h. the disturbance was centred near the Mull of Galloway. Pressure changes were especially rapid along the coasts of Dorset and Hampshire, the barogram at Portland Bill showed a fall and rise of 9 mb. within the 5 hours ending 5h. on the 27th. The highest gusts reached (72 m.p.h.) were reported from Petersfield and South Farnborough. At Kew Observatory there was a gust of 57 m.p.h., and along the coasts many places recorded gusts of over 60 m.p.h. Much damage was done to shipping in the English Channel, and, as the gale was still raging at the time of high tide, the sea broke over the front at several of the south coast towns and flooded the streets.

The total rainfall for the month varied very much over different parts of the British Isles, as much as 340 mm. (13·40 in.) were measured at Benmore (Isle of Mull), 309 mm. (12·17 in.) at Dungeon Ghyll (Westmoreland) and 275 mm. (10·83 in.) at Delphi Lodge (Mayo), while at Middlesbrough (Yorks) and Nairn only 18 mm. (0·70 in.) and 22 mm. (0·88 in.) occurred respectively. For the first time since March the rainfall for the month for the British Isles as a whole was below the average.

Mean pressure for November was above the average over the greater part of Europe, the maximum excess being over the North Sea and Denmark (+7 mb. at Blaavands Huk). Over western Iceland and northern Scandinavia the pressure was below normal (—4 mb. at Vardo). Depressions passing northwards of the British Isles caused many gales on the northern and western

coasts, and heavy weather was experienced on the Atlantic, trans-Atlantic liners being delayed. Temperature was generally above normal, and precipitation deficient, except in the extreme north, where there was a slight excess. After the first few days of the month the stormy unsettled weather, so prevalent in October, gave place to a fine quiet period, with much mist or fog. Some high temperatures were recorded at the beginning of the month, 73° F. at Geneva* on the 3rd, and 72° F. at Toulouse on the 6th. At the end of the month much colder weather prevailed generally, and intense frost persisted in northern Scandinavia, where — 8° F. was reported from Gillivare on the 30th. Snow fell in Scandinavia and in parts of Central Europe. On the 26th-27th a gale swept across north-west Europe. Its effect was mostly felt on the coasts of the English Channel,† but a wind of force 9 (50 m.p.h.) was reported from Rochefort at 8h. on the 26th.

Owing to the long continued drought in the north-eastern United States, which did not break until the middle of the month, many forest fires were reported at first. A light fall of snow occurred in New York on the 9th. Heavy rains occurred in Jamaica and Cuba in the first half of the month, and large areas in Jamaica were flooded.

Floods were again reported in India at the beginning of the month, near Allahabad, but they were not severe enough to cause interruption of traffic. On the 19th, a violent cyclonic storm passed from the Bay of Bengal over the land to the south of Calcutta, causing some damage.

The reports of rainfall in Australia show that rain was generally sufficient. Parts of New South Wales were threatened by floods at the middle of the month, but the rain moderated at the end.

The special message from Brazil states that the rainfall was 9 mm. and 30 mm. below normal in the northern and southern districts respectively. In the central regions the rainfall was very irregular, though the total for the month was 32 mm. above normal. The grain crops in the south, and the cane in the north suffered from the lack of rain. Many anticyclones passed across the country for the time of year. At Rio de Janeiro pressure was 0·8 mb. above normal and temperature 1·3° F. below normal.

Rainfall November, 1924: General Distribution

England and Wales	86	per cent. of the average 1881-1915.
Scotland	68	
Ireland	103	
British Isles	85	

*A temperature of 74°F. was recorded at Geneva in November, 1895, This was the only occasion of such a high reading in November in the years 1851-1900.

† See p. 272.

Rainfall: November, 1924: England and Wales

CO.	STATION.	In.	mm.	Per-cent. of Av	CO.	STATION.	In.	mm.	Per-cent. of Av.
Lond.	Camden Square.....	2·50	63	106	*War.*	Birminghm, Edgbaston	2·02	51	85
Sur .	Reigate, Hartswood...	3·20	81	110	*Leics*	Leicester Town Hall...	2·03	52	...
Kent.	Tenterden, View Tower	3·29	84	109	,, .	Belvoir Castle.....	1·93	49	87
,, .	Folkestone, Boro. San.	2·75	70	...	*Rut .*	Ridlington.....	1·83	47	...
,, .	Broadstairs	2·13	54	86	*Linc.*	Boston, Skirbeck	1·78	45	89
,, .	Sevenoaks, Speldhurst.	3·82	97	...	,, .	Lincoln, Sessions House	1·11	26	59
Sus .	Patching Farm.....	2·40	61	67	,, .	Skegness, Estate Office.	1·53	39	71
,, .	Eastbourne, Wilm. Sq.	2·97	75	85	,, .	Louth, Westgate	1·76	45	68
,, .	Tottingworth Park....	4·29	109	116	,, .	Brigg	1·36	35	60
Hants	Totland Bay, Aston...	2·66	67	85	*Notts.*	Worksop, Hodsock....	1·32	33	67
,, .	Fordingbridge, Oaklnds	38·4	97	112	*Derby*	Mickleover, Clyde Ho..	1·68	43	75
,, .	Portsmouth, Vic. Park.	2·50	63	83	,, .	Buxton, Devon. Hos...	2·56	65	55
,, .	Ovington Rectory	3·58	91	108	*Ches.*	Runcorn, Weston Pt...	1·50	38	54
,, .	Grayshott	3·40	86	100	,, ..	Nantwich, Dorfold Hall	1·53	39	...
Berks	Wellington College...	2·50	63	98	*Lancs*	Bolton, Queen's Park .	2·43	62	...
,, .	Newbury, Greenham..	3·16	80	113	,, ..	Stonyhurst College....	3·88	99	86
Herts.	Bennington House....	...	..	...	,, ..	Southport, Hesketh...	1·50	38	48
Bucks	High Wycombe	2·76	70	111	,, ..	Lancaster, Strathspey.	2·64	67	...
Oxf..	Oxford, Mag. College..	1·80	46	81	*Yorks*	Sedbergh, Akay	5·41	137	104
Nor .	Pitsford, Sedgebrook..	2·29	58	104	,, .	Wath-upon-Dearne ...	1·74	44	85
,, .	Eye, Northolm.....	2·22	56	...	,, .	Bradford, Lister Pk...	2·67	68	91
Beds.	Woburn, Crawley Mill.	2·58	65	113	,, .	Oughtershaw Hall	6·19	157	...
Cam.	Cambridge, Bot. Gdns.	2·18	55	113	,, .	Wetherby, Ribston H..	2·50	63	107
Essex	Chelmsford, CountyLab	3·34	85	...	,, .	Hull, Pearson Park ...	1·66	42	76
,, .	Lexden, Hill House...	3·00	76	...	,, .	Holme-on-Spalding ...	1·59	40	...
Suff .	Hawkedon Rectory ...	2·80	71	123	,, .	Lowthorpe, The Elms.	1·71	43	70
,, .	Haughley House.....	1·85	47	...	,, .	West Witton, Ivy Ho..	1·87	47	...
Norf.	Beccles, Geldeston....	1·24	31	53	,, .	Pickering, Hungate ...	1·27	32	...
,, .	Norwich, Eaton	1·44	37	56	,, .	Middlesbrough	0·70	18	33
,, .	Blakeney	1·89	48	85	,, .	Baldersdale, Hury Res.	2·68	68	70
,, .	Swaffham	2·08	53	86	*Durh.*	Ushaw College	1·67	43	66
Wilts.	Devizes, Highclere....	2·84	72	107	*Nor .*	Newcastle, Town Moor.	1·34	34	55
Dor .	Evershot, Melbury Ho.	4·36	111	102	,, .	Bellingham Manor....	1·62	41	...
,, .	Weymouth, Westham..	3·91	99	126	,, .	Lilburn Tower Gdns...	1·27	32	...
,, .	Shaftesbury, Abbey Ho.	3·86	98	120	*Cumb*	Penrith, Newton Rigg..	3·12	79	94
Devon	Plymouth, The Hoe...	4·31	109	119	,, .	Carlisle, Scaleby Hall .	2·05	52	68
,, .	Polapit Tamar	3·75	95	88	,, .	Seathwaite	14·70	373	108
,, .	Ashburton, Druid Ho..	5·63	143	99	*Glam.*	Cardiff, Ely P. Stn.....	3·75	95	90
,, .	Cullompton	4·48	114	130	,, .	Treherbert, Tynywaun	6·75	171	...
,, .	Sidmouth, Sidmount ..	3·66	93	117	*Carm*	Carmarthen Friary....	2·93	74	59
,, .	Filleigh, Castle Hill ...	3·72	95	...	,, .	Llanwrda, Dolaucothy.	4·64	118	79
,, .	Hartland Abbey.....	2·87	73	...	*Pemb*	Haverfordwest, Portf'd	4·23	107	84
Corn.	Redruth, Trewirgie ...	4·49	114	92	*Card.*	Gogerddan.....	1·99	51	42
,, .	Penzance, Morrab Gdn.	3·10	79	68	,, .	Cardigan, County Sch. .	2·40	61	...
,, .	St. Austell, Trevarna..	5·10	129	104	*Brec .*	Crickhowell, Talymaes	4·00	102	...
Soms	Chewton Mendip	3·87	98	90	*Rad .*	Birm. W.W.Tyrmynydd	4·97	126	75
,, .	Street, Hind Hayes ...	2·65	67	...	*Mont.*	Lake Vyrnwy	4·66	118	84
Glos..	Clifton College	3·12	79	99	*Denb.*	Llangynhafal	1·65	42	...
,, .	Cirencester	2·37	60	77	*Mer .*	Dolgelly, Bryntirion..	4·26	108	69
Here.	Ross, County Obsy....	2·90	74	115	*Carn.*	Llandudno	1·36	35	44
,, .	Ledbury, Underdown.	2·60	66	107	,, .	Snowdon, L. Llydaw 9	10·53	267	...
Salop	Church Stretton.....	2·49	63	85	*Ang .*	Holyhead, Salt Island.	3·03	77	73
,, .	Shifnal, Hatton Grange	1·77	45	74	,, .	Lligwy	2·48	63	...
Staff.	Tean, The Heath Ho...	1·86	47	63	*Isle of Man*				
Worc.	Ombersley, Holt Lock.	2·31	58	101		Douglas, Boro' Cem...	4·31	109	90
,, .	Blockley, Upton Wold.	...	..	...	*Guernsey*				
War.	Farnborough.....	2·73	69	100		St. Peter Port, Grange.	1·81	46	43

Rainfall: November, 1924: Scotland and Ireland

CO.	STATION	In.	mm.	Per-cent. of Av.	CO.	STATION.	In.	mm.	Per-cent. of Av.
Wigt.	Stoneykirk, Ardwell Ho	3·97	101	100	*Suth.*	Loch More, Achfary	5·68	144	66
,, .	Pt. William, Monreith	2·67	68	...	*Caith*	Wick	1·49	38	47
Kirk.	Carsphairn, Shiel.	4·73	120	...	*Ork .*	Pomona, Deerness	2·62	67	67
,, .	Dumfries, Cargen	2·92	74	65	*Shet .*	Lerwick	2·71	69	64
Dum	Drumlanrig	3·39	86	81					
Roxb	Branxholme	1·86	47	56	*Cork.*	Caheragh Rectory	5·55	141	...
Selk .	Ettrick Manse	4·52	115	...	,, ..	Dunmanway Rectory	5·77	147	93
Berk.	Marchmont House	1·57	40	52	,, ..	Ballinacurra	5·20	132	130
Hadd	North Berwick Res.	1·50	38	67	,, ..	Glanmire, Lota Lo.	6·23	158	145
Midl	Edinburgh, Roy. Obs.	1·10	28	51	*Kerry*	Valencia Obsy.	5·39	137	...
Lan .	Biggar	1·77	45	62	,,	Gearahameen	8·60	218	99
Ayr .	Kilmarnock, Agric. C.	2·83	72	75	,, .	Killarney Asylum	4·11	104	73
,, .	Girvan, Pinmore	4·27	109	82	,, .	Darrynane Abbey	3·78	96	74
Renf.	Glasgow, Queen's Pk.	2·57	65	69	*Wat .*	Waterford, Brook Lo.	4·89	124	129
,, .	Greenock, Prospect H.	5·31	135	83	*Tip .*	Nenagh, Cas. Lough	4·16	106	103
Bute.	Rothesay, Ardencraig	3·52	89	69	,, .	Tipperary	4·51	115	...
,, .	Dougarie Lodge	3·53	90	...	,, .	Cashel, Ballinamona	4·57	116	131
Arg .	Glen Etive	9·90	251	...	*Lim .*	Foynes, Coolnanes	3·38	86	85
,, .	Oban	5·49	139	...	,, .	Castleconnell Rec.	4·97	126	...
,, .	Poltalloch	5·60	142	101	*Clare*	Inagh, Mount Callan	...	..	...
,, .	Inveraray Castle	6·91	175	82	,, .	Broadford, Hurdlest'n.	5·12	130	...
,, .	Islay, Eallabus	4·77	121	89	*Wexf*	Newtownbarry	5·13	130	...
,, .	Mull, Benmore	13·40	340	...	,, .	Gorey, Courtown Ho.	2·88	73	83
Kinr.	Loch Leven Sluice	2·57	65	72	*Kilk.*	Kilkenny Castle	4·13	105	134
Perth	Loch Dhu	6·95	177	80	*Wic .*	Rathnew, Clonmannon	2·96	175	...
,, ..	Balquhidder, Stronvar.	4·98	127	62	*Carl .*	Hacketstown Rectory	4·17	106	107
,, ..	Crieff, Strathearn Hyd.	2·43	62	56	*QCo..*	Blandsfort House	4·27	09	128
,, ..	Blair Castle Gardens	2·37	60	...	,,	Mountmellick	5·26	134	...
,, .	Coupar Angus School	2·12	54	76	*KCo.*	Birr Castle	4·09	104	132
Forf.	Dundee, E. Necropolis	2·00	51	82	*Dubl.*	Dublin, FitzWm. Sq.	2·25	57	84
,, .	Pearsie House	2·83	72	...	,, .	Balbriggan, Ardgillan	2·38	61	83
,, .	Montrose, Sunnyside	1·95	50	74	*Me'th*	Drogheda, Mornington	2·71	69	...
Aber.	Braemar Bank	2·24	57	58	*W.M*	Mullingar, Belvedere	4·13	105	121
,, .	Logie Coldstone Sch.	2·18	55	71	*Long*	Castle Forbes Gdns.	4·94	125	137
,, .	Aberdeen, Cranford Ho	2·77	70	86	*Gal .*	Galway, Waterdale	...	..	...
,, .	Fyvie Castle	2·80	71	...	,, .	Ballynahinch Castle	6·80	173	...
Mor .	Gordon Castle	1·31	33	45	*Mayo*	Mallaranny	7·83	199	...
,,	Grantown-on-Spey	1·30	33	43	,, .	Westport House	5·19	132	106
Na .	Nairn, Delnies	0·88	22	37	,, .	Delphi Lodge	10·83	275	...
Inv..	Ben Alder Lodge	3·93	100	...	*Sligo*	Markree Obsy.	5·22	133	123
,, .	Kingussie, The Birches	1·50	38	...	*Ferm*	Enniskillen, Portora	3·07	78	...
,, .	Fort Augustus	...	..	...	*Arm.*	Armagh Obsy.	2·61	66	92
,, .	Loch Quoich, Loan	9·60	244	...	*Down*	Warrenpoint	3·38	86	...
,, .	Glenquoich	8·83	224	73	,, .	Seaforde	3·71	94	98
,, .	Inverness, Culduthel R.	1·03	26	...	,, .	Donaghadee	2·84	72	93
,, .	Arisaig, Faire-na-Squir	4·87	124	...	,, ..	Banbridge, Milltown	2·01	51	73
,, .	Fort William	6·08	154	75	*Antr.*	Belfast, Cavehill Rd.	4·08	104	...
,, .	Skye, Dunvegan	5·42	138	...	,, .	Glenarm Castle	3·73	95	...
,, .	Barra, Castlebay	2·56	65	...	,, .	Ballymena, Harryville	2·95	75	73
R&C	Alness, Ardross Cas.	2·03	52	50	*Lon .*	Londonderry, Creggan	2·87	73	70
,, .	Ullapool	2·02	51	...	*Tyr .*	Donaghmore	3·33	85	...
,, .	Torridon, Bendamph	6·42	163	69	,, .	Omagh, Edenfel	3·23	82	85
,, .	L. Carron, Plockton	...	..	...	*Don .*	Malin Head	3·03	77	92
,, .	Stornoway	4·14	105	71	,, .	Rathmullen	2·99	76	...
Suth.	Lairg	1·89	48	...	,, .	Dunfanaghy	3·92	100	83
,, .	Tongue Manse	2·00	51	44	,, .	Killybegs, Rockmount	6·41	163	102
,, .	Melvich School	2·13	54	53					

Climatological Table for the British Empire, June, 1924

STATIONS	PRESSURE		TEMPERATURE							Relative Humidity	Mean Cloud Am'nt	PRECIPITATION			BRIGHT SUNSHINE	
			Absolute		Mean Values				Mean Wet Bulb.			Am'nt	Diff. from Normal	Days	Hours per day	Percentage of possible.
	Mean of Day M.S.L.	Diff. from Normal	Max.	Min.	Max.	Min.	½ max. and min.	Diff. from Normal								
	mb.	mb.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	%	0—10	mm.	mm.			
London, Kew Obsy.	1016·6	− 0·1	79	44	68·5	52·0	60·3	+ 1·1	57·2	72	6·7	87	+ 32	11	6·6	40
Gibraltar	1016·1	− 1·3	89	60	78·9	65·1	72·0	+ 1·5	64·2	67	3·0	0	− 12	0	...	...
Malta	1015·2	+ 0·6	87	64	79·4	68·6	74·0	+ 2·0	67·7	70	3·5	5	+ 3	4	10·7	74
Sierra Leone	1012·7	0·0	91	69	85·7	72·2	78·9	− 1·6	75·7	82	6·5	674	+184	28	...	...
Lagos, Nigeria	1010·1	− 2·8	91	72	86·7	75·6	81·1	+ 2·5	77·0	76	4·9	140	−343	14	...	...
Kaduna, Nigeria	1014·0	+ 0·2	99	65	86·5	69·6	78·1	+ 1·6	72·8	81	1·1	201	− 24	18	...	...
Zomba, Nyasaland	1017·2	− 0·2	80	49	74·1	54·1	64·1	+ 1·6	...	87	4·5	10	− 5	4	...	...
Salisbury, Rhodesia	1018·3	− 1·9	77	36	71·5	45·9	58·7	+ 2·3	51·0	58	2·1	2	+ 1	1	...	...
Cape Town	1020·0	− 0·3	73	36	62·5	47·3	54·9	− 0·9	51·7	79	5·5	121	+ 8	16	...	...
Johannesburg	1024·0	− 0·4	68	28	59·9	39·9	49·9	− 0·8	38·3	54	1·4	1	− 2	1	9·6	91
Mauritius	1020·1	+ 1·1	77	61	75·0	64·0	69·5	+ 0·1	...	78	5·3	37	− 34	11	7·0	65
Bloemfontein	...	...	71	18	61·3	29·4	45·3	− 2·3	35·5	69	0·1	1	− 11	1	...	...
Calcutta, Alipore Obsy.	998·4	− 1·3	111	74	97·6	81·5	89·5	+ 4·4	80·7	77	6·5	211	− 79	5*	...	...
Bombay	1004·3	+ 0·1	95	76	90·5	81·3	85·9	+ 2·0	78·8	73	5·6	189	−280	11*	...	...
Madras	1003·9	+ 0·1	107	74	101·6	81·5	91·5	+ 1·6	75·7	53	6·4	88	+ 40	6*	...	...
Colombo, Ceylon	1009·3	+ 1·0	87	73	85·5	76·6	81·1	− 0·8	77·8	76	8·8	177	− 15	22	4·9	39
Hong Kong	1005·1	− 1·0	90	73	84·3	77·6	80·9	− 0·6	76·6	83	8·9	588	+190	21	4·2	32
Sandakan	...	...	90	73	87·9	75·0	81·5	− 0·2	77·5	79	...	124	− 61	9	...	...
Sydney	1020·1	+ 2·2	77	40	62·2	47·4	54·8	+ 0·4	49·4	68	5·0	51	− 76	12	5·2	53
Melbourne	1020·2	+ 1·7	60	34	54·6	42·9	48·7	− 1·7	46·5	80	7·1	30	− 23	21	3·0	32
Adelaide	1021·3	+ 2·2	64	35	59·1	45·3	52·2	− 1·2	47·8	74	5·9	94	+ 16	16	4·5	47
Perth, W. Australia	1019·9	+ 1·9	74	42	65·5	49·1	57·3	+ 0·7	52·1	70	5·0	130	− 42	14	5·2	52
Coolgardie	1021·2	+ 2·1	76	36	64·5	43·5	54·0	+ 1·3	48·7	38	4·1	5	− 26	3	...	...
Brisbane	1019·7	+ 1·7	75	43	68·1	50·7	59·4	− 0·7	55·2	66	4·5	122	+ 57	7	6·6	65
Hobart, Tasmania	1015·1	+ 0·8	61	33	52·1	40·1	46·1	− 0·7	43·1	77	5·8	71	+ 15	15	4·1	46
Wellington, N.Z.	1016·1	+ 1·8	62	32	55·6	44·8	50·2	+ 0·5	47·2	79	6·4	75	− 46	21	4·0	43
Suva, Fiji	1014·5	+ 0·9	84	67	79·0	70·9	74·9	0·0	72·8	87	7·4	639	+483	23	...	...
Apia, Samoa	1012·3	+ 0·7	88	71	84·9	74·3	79·6	+ 2·0	76·3	80	6·3	258	+121	15	6·6	58
Kingston, Jamaica	1013·9	+ 0·1	93	70	89·8	73·3	81·5	− 0·2	74·7	67	6·0	20	− 85	4	...	...
Grenada, W.I.	1014·0	+ 0·7	88	72	84·3	74·4	79·3	+ 0·5	75·5	78	5·7	148	− 71	26	...	...
Toronto	1013·0	− 1·3	82	39	73·1	52·7	62·9	+ 0·3	56·7	71	5·1	44	− 26	14	8·6	56
Winnipeg	1012·3	− 0·2	84	32	71·0	45·9	58·5	− 3·7	57·9	73	4·6	29	− 54	9	8·4	52
St. John, N.B.	1012·3	− 1·7	75	42	64·6	47·6	56·1	− 0·4	51·3	77	6·1	59	− 24	12	7·6	49
Victoria, B.C.	1017·1	+ 0·2	83	45	64·6	48·9	56·7	− 0·3	51·1	78	4·0	14	− 10	7	9·2	57

* For Indian stations a rain day is a day on which 0·1 in. (2·5 mm.) or more rain has fallen.

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The Magazine may also be purchased from THE METEOROLOGICAL OFFICE, SOUTH KENSINGTON, LONDON, S.W.7.

The Fog of December 10th-11th, 1924

London Fogs from above

THE recent fogs which disorganised the normal routine and life of London and the South of England generally, provided an excellent opportunity of settling a number of questions which have for some years been the subject of much argument and discussion—intelligent and otherwise. Arrangements had been made for a kite balloon to be flown at the Croydon Aerodrome during foggy days and nights, for collecting reliable data regarding the visibility of lighting apparatus, and for investigating the possibility of devising ways and means of bringing aeroplanes into an aerodrome completely enveloped in one of London's "particulars."

During the first night's fog, this balloon was sent up from Croydon, and on reaching approximately 300 feet above ground level, came out into brilliant moonlight; the observers in the balloon looked down on an almost unbroken sea of swirling mist, the dirty white colour of which was reminiscent of the North Sea on a grey winter's day. During the ascent of the balloon through the 300 feet thick belt of fog nothing was visible in any direction, and all sounds coming up from the ground were muffled to an indistinctness that made them appear very far away. Once above the fog, the ground noises such as the roar of an aeroplane engine on test, the whistling of steam trains, the barking of dogs, and the shrieking discordance of motor horns came up in the

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fog with startling clearness, and the balloonists were irresistibly reminded of the game of "Blind Man's Buff"—voices everywhere, but nothing to be seen.

As the balloon rose completely clear of the last vestige of the swirling mists a few lighter patches breaking the grey monotony of the view showed up at different points. The most conspicuous of these patches was a red-tinted glow, reminiscent of a sunset seen through mist, but flashing on and off with mechanical regularity. This was the Neon Beacon which is installed at the Croydon Aerodrome as a guide to the night flying aviator, and which has been seen on clear nights at distances up to 45 miles. Some thousand yards or so to the East, a large patch of white light was seen moving slowly to and fro as the 36-inch searchlight (of over 250,000,000 candle power) was swung by the crew below. As the balloon rose these two lights (the beacon and the searchlight) became clearer and more easily recognised, and then a number of other lights were noticed and began to take definite character; high-powered experimental lights were seen first, and finally at 2000 feet it was possible to pick out individual lights of as low a brillancy as 300 candle power.

The general impression obtained from this first night ascent was that with a fog belt not more than 300 or 400 feet deep, it is a comparatively simple matter to indicate the position of an aerodrome to aircraft flying immediately over or very close to the aerodrome itself provided the craft are in the clear upper air.

The next set of observations was made during the forenoon of Wednesday, December 10th; on this occasion, the balloon went up just before mid-day, and the fog was found to be of about the same depth as on the previous evening. At 300 feet the balloon came into brilliant sunshine and within a few minutes the crew were unbuttoning the heavy leather flying kit which had failed to keep them really warm down on the ground; the sun's rays at this height and the complete stillness of the air brought memories of summer and a sympathetic pity for the earthbound workers condemned to grope their way around in a cold clammy cheerless world.

The same sound phenomena were noticed; ground noises were quite distinct, though in the fog everything had been damped down. At different points around the horizon, patches of high ground could be seen standing out of the fog bank and evidently enjoying the same brilliant sun that was warming the aeronauts. In general, the upper surface of the fog was comparatively level, but over the railway stations this evenness of surface was lacking, and large woolly mounds of fog projected in irregular formation above their surroundings; the variation in the height of these mounds at intervals led the observers to think that the presence of trains in the stations actually produced changes in the fog

above them, and this certainly seems to be the case. The railway stations at East Croydon and Purley were readily located by the uneven patches of fog above them. It was also noticed that the main-line connecting Croydon and Purley was quite distinct as there was an obvious furrow of uneven patches extending between the two stations. This phenomenon would not, of course, be of much value to an aviator endeavouring to locate his position as it was only by careful watching and a definite knowledge of their surroundings that the aeronauts were able to trace the line of railway.

Pyrotechnic star shells were fired up from the ground while the balloon was flying, and the resulting firework display some hundreds of feet above the fog surface provided a fresh interest; these star shells—red, white and green in colour—were very effective in their operation, but would not have been seen except by pure luck by an observer who did not know exactly in what direction to look for them. Apart from these projectiles fired above the fog, nothing was seen of the devices operated on the ground, which included various lights of high intensity. Among those enjoying the sunny warmth of an upper place were numerous birds—mostly starlings, which were flying about in a somewhat aimless fashion and occasionally perching on the cordage of the balloon. The majority of these starlings were very obviously lost, and many of them seemed completely exhausted, giving the impression that they had flown on and on above the fog in the hope of finding somewhere to land, and the balloon observers propounded the theory that some birds are almost as much handicapped in finding their way over unbroken fog as pedestrians are on the ground. Two seagulls were also seen flying steadily towards south-west—they apparently knew where they were going and seemed not in the least distressed.

Later observations made when the fog belt hung at between 500 feet and 900 feet above ground, produced an entirely different set of results from the lighting apparatus; on these occasions, no lights of any description were visible when the balloon was above the fog belt in a clear starlight night. At about 1200 feet and even on ascending to 3000 feet the same negative results were obtained.

The net conclusions were that with fog on the ground and only some 300-400 feet thick, powerful lights directed upwards can readily be seen by an observer high above the fog, but that when a fog belt is some hundreds of feet above the light sources it is not possible to project light through this belt. Another interesting point noted was that on some foggy nights red lights were most easily distinguishable and were seen at the greatest distance. On other nights on which the visibility was approximately the same, green lights were much better than red or

white lights, and on yet other occasions white lights were easily the best. The general impression gained at the conclusion of the experiments was that the fog bugbear which has baffled surface travel for generations and completely disorganises London's business, will be defeated to a very great extent by aerial transport, which has the advantage of being able to climb above the majority of fog belts and proceed across country guided by wireless telegraphy. This desirable state of affairs will not, of course, come into being without much careful and laborious research and experiment into the problem of getting departing aircraft safely up through the fog and bringing them down again through fog at their destination, but there is every indication that in a few years air services will be maintained with a regularity denied to surface organisations. C. H. BIDDLECOMBE.

Town and Country Observations

IT may be worth while to record some observations and impressions of the fog last week.

(1) It appeared much more of a mist than a fog. This is borne out by the fact that in the neighbourhood of Kingsway it was much less dense than in the northern suburbs. This was noticed both on coming in to town in the morning and on return at night, while information collected from others corroborated the observation. At night going home along a lane, not very well lit at the best, it was only under a lamp that the kerb could be seen, while in town one could always distinguish objects across the street.

(2) It is thus suggested that the heat of the town itself evaporated a certain proportion of the water particles near the ground and so cleared the air for a short vertical height. The smoke rose above the level of the houses, but was apparently then trapped, for it was quite as dark as on a dark night. Though there was no sign of the yellow fog, and there appeared to be comparatively little smoke at ground level, some unpleasant substances were present, as the eyes smarted.

(3) In the northern suburbs the fog appeared to be only a very dense mist drifting in from the north. Even though little air motion could be felt, the movement of the air particles appeared quite rapid, say three miles an hour.

(4) Notwithstanding the apparent cleanness of the mist or fog, I do not remember to have ever seen so much dirt left on the surface of the ground. All horizontal outdoor surfaces were coated with a very thin greasy-looking black film. Leaves, which had been lying on the grass during the fog, left a print of clean grass when picked up. Ground dug when the fog cleared contrasted strangely with ground dug just before the fog began.

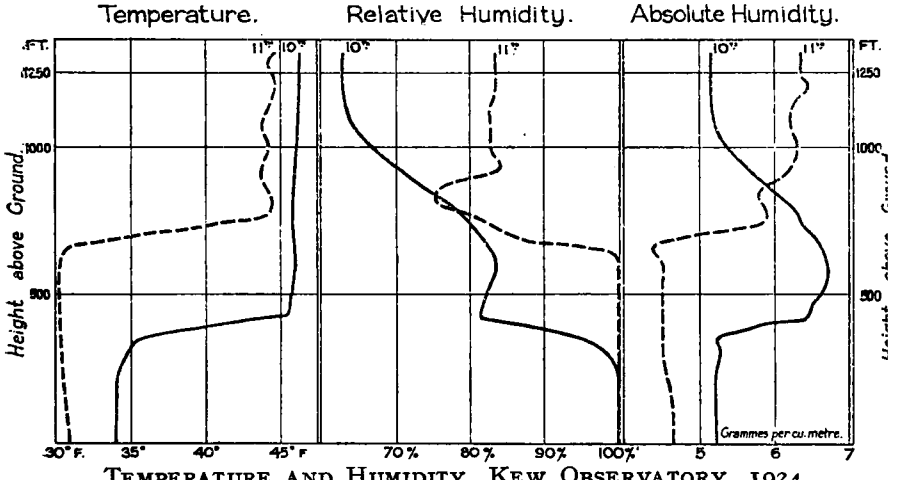
That this black film was not deposited just when the fog disappeared was evident from the fact that a doormat which had been repeatedly moved had left an impression of each of its overlapping positions clearly seen. The deposition of the film was evidently a continuous process.

With the oncoming of rain, the film disappeared entirely. The grass was washed quite clean, and there was apparently no difference between ground dug before and ground dug after the fog.

J. FAIRGRIEVE.

Temperature and Humidity in and above the Fog

AT Kew Observatory there is a captive balloon which can be sent up in fog. The apparatus used with the balloon for obtaining records of temperature and humidity was described in the *Meteorological Magazine* for August, 1923, *p.* 164. The instrument weighs about a pound, and was intended primarily to locate the upper limit of a fog rather than to yield very minute details. The scale of the records is rather small.



TEMPERATURE AND HUMIDITY, KEW OBSERVATORY, 1924
14h. 20m., DEC. 10TH, AND 10h. 40m. DEC. 11TH.

The graphs shown in the figure were obtained by Mr. L. H. G. Dines from soundings in the great fog of December 10th and 11th, 1924. On each of these days the balloon was sent up at a rate of about 400 feet per minute, and pulled down after a wait of four minutes. The average rate of descent was about 60 feet per minute, the procedure being to pull for one minute at the rate of 90 feet per minute and then to wait half a minute. This system was adopted so that any lag in the hygrograph or thermograph might be discovered and roughly estimated. Only the descending record was employed in preparing the graphs.

An unusual feature of the case was the almost entire absence

of wind at all levels reached, and, as the instrument is not artificially ventilated in any way, it will be appreciated that the hair hygrograph is bound to lag. The effect is clearly shown on the original records, and it is a fair inference that the level at which the relative humidity reached 100 per cent. was really in each case a little higher than the graphs indicate. The general shapes of the humidity graphs may, however, be accepted as correct, and as the instrument was specially calibrated on the 10th down to 72 per cent., the absolute values cannot be much out, but too much reliance should not be placed on minute details. The thermograph, being constructed of very thin metal, did not show any undue lag, and its record may be more confidently accepted. On both days the original record of temperature shows a slight but definite tendency to fall with increasing height up to the level of the inversion : above that the temperature was practically uniform, but the absolute humidity quite definitely was not. On the 11th the driest region was just above the inversion, on the 10th the dryness increased with height from 600 feet upwards. The latter feature is confirmed by an earlier ascent made on the same date.

The reduction in the absolute humidity inside the fog as compared with that just above the fog is due, of course, to condensation : on the assumption that the air had the same total water-content in and above the fog, the amount of water in suspension can be estimated. In the fog of December 10th the proportion of water in the gaseous and liquid states was about 5 gm./m^3 and 1·5 gm./m^3 respectively. On the 11th the corresponding figures were 4·5 gm./m^3 and 1·4 gm./m^3.

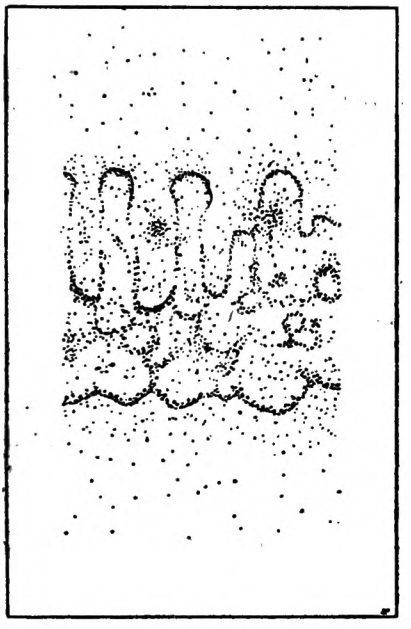
The dryness of the clear air above the fog on the 10th implies that its past history must have differed considerably from that of the lower air. This upper layer may have settled down from greater heights, or it may have drifted from the Continent over the stationary fog. On the other hand, the air which was over the Observatory on the 11th seems to have been derived from a single source of supply.

The slight decrease in temperature from the bottom to the top of the fog is consistent with heating by contact with the ground. At Kew Observatory the temperature at 12 inches below the surface of the soil was very steady at 40°, at 4 inches the temperature was 37°. There must have been a regular flow of thermal energy from soil to air. Mr. Fairgrieve's observations suggest that the heat from the soil causes the evaporation of some of the fog droplets, the warmed air with its water vapour ascends and the wet adiabatic lapse rate is thereby maintained through the fog. The convection is probably by currents on a rather coarse scale : it is well known that the air in a fog is seldom stagnant.

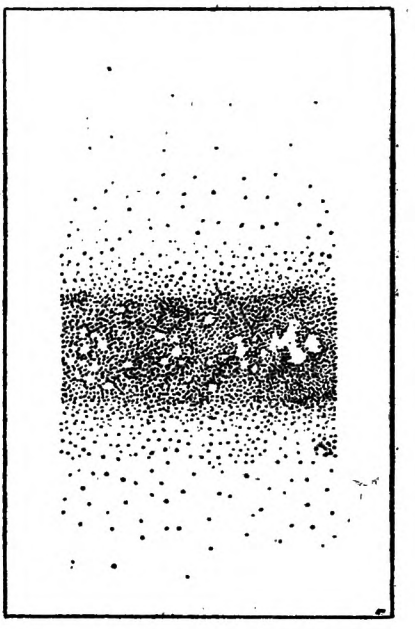
F. J. W. W.

Observations with the Jet Dust Counter

DURING the period of widespread fog between December 9th and 12th, 1924, London suffered from the usual combination of smoke and water fog which we have learnt to expect under such conditions at present. The following observations were made bearing upon the nature of the fog over London. A dust record taken at Cheam, about 11 miles south-west of London, on December 11th at 8h. 45m., using 50 c.c. of air, showed a



TYPICAL SECTION FROM DUST RECORD. CHEAM, SURREY. 11TH DEC. 1924. (NOTE STREAMBEDS AND SMALL DUST CONTENT.) MAGNIFICATION APPROXIMATELY 250 DIAMETERS.



TYPICAL SECTION FROM DUST RECORD. LONDON. 11TH DEC. 1924. (NOTE ABSENCE OF STREAMBEDS AND LARGE DUST CONTENT.) MAGNIFICATION APPROXIMATELY 250 DIAMETERS.

dust trace from the sides of which were large numbers of dried-up stream beds; the trace itself showed indications of a large quantity of water having impinged upon the glass. The number of dust particles was between 4,000 and 5,000 per c.c., with an average diameter of about half micron. The limit of visibility at the time was about 70 yards. On going to London a second record was taken at noon when the fog was about at its worst, and this showed little or no evidence of water and no lateral streams, while the number of dust particles was about 27,000 per c.c., and the diameters from 2 microns down, a large proportion being over 1 micron.

There was thus roughly 50 times as much impurity by weight in the London fog as at Cheam, while there was a much larger amount of water at Cheam. The small size of the particles at

Cheam points to the grading effect of settlement, while on the morning of the 11th, the roads in the neighbourhood were covered with a thin oily looking film, showing that active settlement was going on. It appears justifiable to infer from the above that the " London Particular " is formed rather by a replacement of water particles by smoke than by the dirtying of the condensed water by smoke, and this appears a reasonable result to expect from the higher temperature of the air over London. It further appears improbable that water vapour would condense round oily soot particles when there are ample numbers of hygroscopic nuclei present.

I have several times observed that during a white fog at Cheam the limit of visibility was less than in London, while the number of soot particles in London was invariably greater. It is hardly possible to get an improvement of visibility by adding smoke particles to the air unless there is a coincident reduction of the water particles.

J. S. OWENS.

OFFICIAL PUBLICATIONS

The following publications have recently been issued :—

PROFESSIONAL NOTES—

No. 35. Report on Observations of Atmospheric Electricity and Terrestrial Magnetism made at Kew, Stonyhurst and Eskdalemuir Observatories on the occasion of the Solar Eclipse, April 8th, 1921. By C. Chree, Sc.D., LL.D., F.R.S., H. W. L. Absalom, B.Sc., A.R.C.S., D.I.C., and E. Taylor, M.A., B.Sc. (No. 245*o*.)

RÉSEAU MONDIAL 1916. Part V. of the British Meteorological and Magnetic Year Book 1916. (M.O. 227*g*.)

Royal Meteorological Society

THE monthly meeting of this Society was held on Wednesday, December 17th, at 49, Cromwell Road, South Kensington. Capt. C. J. P. Cave, M.A., President, in the Chair.

C. E. P. Brooks, M.Sc.—The Problem of mild Polar Climates.

The benefits which the animal creation derives from the fact that ice floats on water instead of sinking to the bottom have often been emphasized. It is only recently that attention has been called to the other side of the question. Because ice floats, the Arctic regions wear a mantle of snow and ice, and such radiant heat as reaches the surface is mostly reflected away. Low

temperature breeds low temperature. Moreover, the icebergs, which are carried south, cool the surface waters of the Atlantic and reduce the warming power of the Gulf Stream. From such facts as these Mr. Brooks (following F. Kerner-Marilaun) shows that there is a break in the range of possible climates for the northern hemisphere. If the polar regions received in some way a little more warmth each year there might result a very great increase in temperature. According to the geological evidence there have been times when the climate, say at Spitzbergen, was as mild as that enjoyed at present by the Channel Islands. It is suggested that at these times, the Middle Eocene and Upper Jurassic, the distribution of land and sea was such that three wide channels led to the Arctic Ocean from more southerly latitudes, so that there was much opportunity for warm water to flow north and provide heat enough to ensure the ocean remaining open throughout the year. Mr. Brooks does not confine his attention to the distant past, and an interesting by-product of his investigation is the suggestion that as recently as the tenth century the Arctic Ocean was free from ice. In support of this suggestion he quotes (*inter alia*) the absence of any reference to ice in the Sagas which tell of the early voyages between Iceland and Greenland.

Sir Napier Shaw, F.R.S.—"Winds and Temperature in a dry Atmosphere."

At the meeting of the British Association at Toronto, Sir Napier Shaw read a paper with the striking title "If the World Went Dry." The paper has since been published in *Nature** Sir Napier gave an account of this paper and of some of the arguments on which it was based, and invited discussion. The hypothesis on which he proceeds is that air deprived of water vapour would be perfectly transparent both to light and heat. He comes to the conclusion that in middle and equatorial latitudes the atmosphere over any particular spot would be isothermal by night, and that by day gradual convection from the ground would warm the air in the lowest 6,000 feet; the steady state would persist at greater heights throughout the 24 hours. To complete his picture, Sir Napier postulates lofty bosses (such as Greenland and the Antarctic) at the poles, and points out that the flow of cold air down the slopes of these bosses is a process which would persist even if the world went dry. There was a lively discussion which brought out some of the difficulties of the problem. For example, it was mentioned that we have no practical experience of an atmosphere entirely free from water. Sir Napier had utilised the records of diurnal changes of temperature in Egypt, but there is actually more water vapour in

**Nature, London,* Vol. 114, 1924, *p.* 684.

the air of Egypt than in that of Great Britain. To trace the extent to which the range of temperature is affected by this water vapour is by no means easy, and Sir Napier rightly challenged his critics to improve on the estimates he had made in this and other parts of his paper.

Correspondence

To the Editor, *The Meteorological Magazine*

The Reform of the Calendar

THE letter from myself which you published in August on Calendar Reform, and on which Sir Napier Shaw made comment in November, certainly did assume that " the 13 months Year " and the " Dies Non " advocated by the U.S. Weather Bureau, were designed to cover many, if not all, departments of life. This assumption is borne out by a phrase used by Professor Marvin, who " would stop the wanderings of the days of the week through the months." This can mean nothing but a break in the sequence of week days, and that not only for meteorological purposes. It would mean that the first day of every month if once, say, Monday, would always be a Monday: that the Calendar for one year would be a Calendar for all years, except that in Leap Years there would be two days at the end which were not week days at all! It will not be admitted unanimously that there would be gain from such monotonous uniformity. The existing diversity from year to year may even be thought preferable.

It should, however, be well considered what this " Reform " is going to mean in ordinary life. It is a fact of tremendous importance that " a seven-day week with one Holy Day " is common to the three most widespread, if I may not say the most important, religions in the world—Jew, Christian and Moslem. The Jews have been keeping the seventh day as the Sabbath for more than 3,000 years: the Christians the first day as the Lord's Day for close on 1,900 years, and the Moslems the sixth day as their sacred day for full 1,300 years. There is no reason to think that the days of the week ever " got wrong." They hardly could have done. The *onus probandi* lies on those who would say that they did. Even the considerable upset caused in 1582 and after by the Gregorian Calendar Reform did not touch the days of the week. Moslems, Jews and Christians (Latin, Greek or Protestant) went on with their Fridays, their Sabbaths and their Lord's Days just as before. It will be a very serious matter to break the sequence of week days. It will be a matter of conscience. Where is the authority that can impose obedience on all these? A pity indeed to begin the quest for uniformity

by breaking up the greatest bond of agreement that the worl has yet seen!

One may earnestly desire a very radical revolution in the Civi Calendar, and yet plead that the sequence of week days, and th Lunar Basis of the Christian Easter shall be left untouched Other ways are open.

H. A. BOYS, F.R.Met.Soc.

Spring Hill, S. Mary Bourne, Andover. December 3rd, 1924.

Shakespeare's Use of Meteorology

To think of and represent Nature as manifesting sympathy witl human emotions has been a favourite conceit of poets all down the ages, and Shakespeare has not been behindhand in em ploying this device in his works. How the terrible scene o Lear's madness is enhanced by the storm in the external worl which seems to match the storm in the old king's soul; an what an atmosphere is created in "Macbeth" during the trys of the three weird sisters on the blasted heath and on the nigh Duncan is slain.

Another great storm in Shakespeare is the storm befor Cæsar's death. Casca, meeting Cicero, says:—

> "I have seen tempests, when the scolding winds
> Have riv'd the knotty oaks; and I have seen
> The ambitious ocean swell, and rage, and foam,
> To be exalted with the threat'ning clouds:
> But never till to-night, never till now,
> Did I go through a tempest dropping fire.
> Either there is a civil strife in heaven;
> Or else the world, too saucy with the gods,
> Incenses them to send destruction." (Act i., 3

Shakespeare's last play is about a "Tempest." But th period of the tragedies, the period of storm, was then over fo ever, and that "Tempest" was a wind which blew nothing bu good.

CICELY M. BOTLEY.

10, *Wellington Road, Hastings. December 11th, 1924.*

Sunshine and Shadow on Christmas Eve

WE had quite a sharp thunderstorm here on the 24th. Rai began at 10h. 20 m., and lasted till 11h. 30 m., in which tim 0·32 in. fell. About 11h. there was a flash of lightning, followe by a very loud and long rumble of thunder. There was anothe flash and clap nearer afterwards, and one or two more distinc claps. The storm came up from the southwest with the wind Later there were more storms of rain, making a total for th 24 hours of 0·72 in., and at 15h. 30m. it was too dark in the hous

to see needlework. Then the sun came out and, reflected from a cloud in the southeast, made the eastern rooms almost lighter than the western, the cloud looking a bright soft yellow. I hear there was a very fine rainbow and fine effects from wet roofs.

ELEANOR M. TAWNEY.

114, *Northmoor Road, Oxford. December 26th*, 1924.

Great Variation in (Local) Annual Rainfall

IT is a remarkable fact that this last leap year period (1921-1924) has supplied me with the greatest contrast in annual rainfall I have ever registered personally; and, so far as I can trace, the greatest contrast ever noted about London. My own record for the year 1921 was 15·46 in.; for 1924, 37·88 in.; the difference being roughly 144 per cent. I am wondering whether any greater oscillation than this has ever been noted in the neighbourhood of London.

WILLIAM GODDEN.

20, *Richmond Avenue, Willesden, N.W.* 10. *January 5th*, 1925.

NOTES AND QUERIES

The Week-spell Calendar

IN the *Meteorological Magazine* for November, 1924, Sir Napier Shaw announced his intention to make a calendar for 1925 to show the division of the year into "week-spells." On New Year's Day Sir Napier's friends received a booklet containing "The Kalendar for 1925," as well as much useful information about the radiation observations made at English observatories during 1924 and now set out in the appropriate week-spells.

In 1925, each week-spell will begin with Thursday (for New Year's day was on Thursday). In 1924, the week-spells began with Tuesday at the beginning of the year, with Wednesday at the end. The change occurred after the 8-day week which according to Sir Napier was from Tuesday, June 24th, to Tuesday, July 1st. Some meteorologists may think that it would be better to allow the 8-day week to be the week in which February 29th falls. The Book of Common Prayer allots a letter to each day of the year. January 1st has the "Dominical Letter" A. January 2nd, b, and so on. The sequence A . . . . g, A . . . . g is interrupted only by February 29th to which no letter is allotted. If these letters are regarded as giving names to the days A-day, B-day, etc., then February 29th which falls between a C-day and a D-day will require a name, say L-day. With the Prayer book convention a day such as June 2nd would have the same

designation, F-day, Week-22, every year. With Sir Napier's rule, June 2nd is an F-day in ordinary years, but a G-day in leap years. Each system has its advantages.

The tabulation of observations by week-spells is unobjectionable as long as it is confined to data of purely scientific interest. It is to be remembered, however, that the distinction between pure and applied science is always ill-defined. To many the Weekly Weather Report of the Meteorological Office is a purely scientific document. It is intended, however, to supplement the returns of the Registrar General and the Board of Agriculture and should be governed by the same rules. Would the adoption of the standardized weeks in those returns be practicable or popular ?

Estimation of Height of Low Cloud

WITH a view to discovering to what degree of accuracy it may be possible for an experienced observer to estimate the height above ground of the base of low cloud, tests have been conducted recently at the meteorological stations at Andover and Biggin Hill. During the period of the tests, three months, the observers entered each morning in the pocket register an estimate of the height of any low cloud that was present, this being done before any measurement for that day was made ; whenever the clouds were suitably placed their heights were measured by timing a pilot balloon till it entered one, it being assumed that the rate of ascent of the balloon was correctly given by the usual formula as a fraction of the weight and " free lift."

The results obtained indicate the high degree of proficiency which can be acquired in making estimates of this sort by men who for several years have been making daily observations of cloud height by means of pilot balloons and otherwise. At the first station, Andover (200 ft. above sea level), where the cloud height as measured varied from 250 to 5,500 feet (most of the cases being below 3,000 feet), the " probable error " in the estimate worked out at about 150 feet. At Biggin Hill (600 ft. above sea level), cloud height varied from 100 to 3,000 feet, and the " probable error " was found to be about 220 feet. The first station is on the east side of Salisbury Plain, in reasonably level surroundings, and the staff have all been there for some years. The second station is on the North Downs, a ridge which itself plays a large part in local cloud formation ; moreover, conditions were less favourable for this comparison in that two out of the three members of the staff had recently been transferred from other places and were consequently less familiar with local conditions. At both stations the tendency was towards underestimation.

Meteorology and Terrestrial Magnetism
Magnetic Quiet and Disturbed Days

THE British representatives on the Meteorological Section of the International Union of Geodesy and Geophysics gave, at Madrid, their support to a proposal that a comparison should be made between meteorological conditions on days characterised by quiet and disturbed states of terrestrial magnetism. The proposal, which is due to Dr. Chree, and was mentioned in his last presidential address to the Royal Meteorological Society, was not adopted by the International Union, but it is to be hoped that such a promising line of research will not be neglected. The "magnetic character" of each day is reported monthly to de Bilt from about 40 observatories, and by the aid of these reports five quiet days and five disturbed days are selected. The statistics are published in bulletins issued by the Institut Meteorologique Royal des Pays Bas: there are four quarterly bulletins and an annual one. From the last two quarterly ones we copy the lists of quiet and disturbed days for the first half of 1924:—

	QUIET.					DISTURBED.				
January ..	1	12	13	14	20	10	22	23	29	30
February ..	14	15	18	28	29	5	6	20	21	23
March ..	1	14	15	17	28	7	8	20	30	31
April ..	4	5	11	13	30	6	7	17	25	26
May ..	6	7	14	18	31	2	22	23	24	28
June ..	3	6	7	8	14	10	11	18	19	20

For any meteorological influence it would be natural to look to the phenomena on the five disturbed days. These are the likely days for aurora. If for example the daily range of temperature is affected by the same causes as produce the magnetic storms, a comparison of the daily range on the five disturbed days with that for the whole month should bring out the relation. When there is a sequence of two or three disturbed days the chances of detecting an interconnection with other geophysical elements should be enhanced.

Air Temperature Near the Ground

REMARKABLE results were obtained in some observations of air temperature reported recently* by Monsieur W. Mörikofer, of Bâle. In his experiments the air temperature was determined by ventilated thermometers. Over ground heated by direct sunshine the lowest layers were hotter than the free atmosphere,

* W. Mörikofer (Bâle).—La température de l'air dans la couche d'un mètre d'épaisseur au-dessus du sol. *Compte Rendu de la séance de la Société Suisse de Géophysique, Météorologie et Astronomie.* (G. H. A.)

the excess amounting in some cases to 10°C. The excess persisted up to 50 cm., but between 60 cm. and 90 cm. all the observations showed a stratum of air a little colder than those above and below it. A similar phenomenon was noticed over an area of snow surrounded by pasture. Immediately above the snow the air was at 0°C.; at 10 cm. the temperature of the free air was reached, but from 40 cm. to 80 cm. there was a layer 0·5°C. colder.

Researches on air temperature are numerous and it is hardly to be supposed that such paradoxical phenomena could have escaped notice hitherto. It is to be hoped that Monsieur Mörikofer will continue his experiments and find the explanation of the anomalies.

Investigation of Winter Thunderstorms, 1925

MR. S. MORRIS BOWER proposes to continue, in conjunction with the Meteorological Office, the annual record of winter thunderstorms hitherto made by Capt. C. J. P. Cave, of Petersfield: this can only be carried out with the assistance of observers in all parts of the country. Mr. Bower would therefore be glad if observers would send to the address given below particulars of any thunder or lightning they may observe between January 1st and March 31st, 1925, inclusive.

A simple note of the date and time of the occurrence of thunder and lightning in any place and the direction in which the lightning was seen, especially at night, would be very valuable. Any additional information would be extremely welcome, as for instance:

(i.) An estimate of the severity of the storm.
(ii.) The time when the storm passed overhead, if it did so, and how long it lasted.
(iii.) Whether it was accompanied by rain, hail or snow.
(iv.) Direction and strength of wind; change of wind, if any.
(v.) Whether there was a change in temperature during the storm.
(vi.) Any other observation which may be of particular moment.

Reports from all parts of the country are desired, especially from Scotland, Ireland and the North of England.

Notes should be sent by postcard or letter to Mr. S. Morris Bower, Langley Terrace, Huddersfield.

The Rainfall of 1924

IT has only been possible so far to ascertain in broad outline the features of the rainfall of 1924. There is no doubt that over the country as a whole the year was unusually wet, the general value

for the whole British Isles being provisionally computed as 117 per cent. of the average, or as 48·5 in. According to this estimate the year was wetter than any since 1903, when the general rainfall was 127 per cent. of the average, or 52·5 in. The rainfall of 1924 only slightly exceeded that of the years 1916 and 1912, which had 115 and 116 per cent. of the average respectively. Although 1924 stands out as a wet year, there were considerable areas over the British Isles in which the rainfall for the year did not reach the average. Less than the average occurred over a broad band stretching from Glasgow and Fort William in the west to Elgin, and also in the valley of the Tweed and over a large area stretching inland from the Lincolnshire coast as far as Barnsley. At Louth, in Lincolnshire, the fall was only 89 per cent. of the average.

In most parts of Scotland the total for the year was within 10 per cent. of the average, and it was only along the east coast from Aberdeen to Dundee that as much as 120 per cent. occurred. In Ireland the fall everywhere exceeded the average, and more than 120 per cent. was recorded over a large area. In parts of Down, Sligo and Wexford the total for the year exceeded 130 per cent. At Ballinrobe, near Loch Mask in Mayo, the largest annual total since the record began in 1877 was recorded. It was in England and Wales that the greatest excesses occurred. Falls of more than 120 per cent. were widespread. More than 120 per cent. occurred everywhere to the south-west of a line from Snowdonia to the Thames Estuary, except along a coastal strip of Wales. More than 140 per cent. occurred on Dartmoor, on the Cotswolds, and over small areas to the north of London e.g. at Maidenhead and Chelmsford. At High Wycombe, in Buckinghamshire, the fall was 38·94 in., being 13·04 in., or 50 per cent., above the average, and the largest total (with the one exception of 1903) since the record began in 1846. At Camden Square (London) the fall for the year of 33·08 in. was 8·61 ins., or 35 per cent., above the average. This was the largest total since 1916. There were 188 days with rain, the duration of rain was 539·6 hours, and the evaporation from a free water surface 14·47 in.

The year opened with a month of heavy rainfall giving 125 per cent. of the January average, but both February and March were unusually dry, the fall over the whole country being only about half the average in both months. February, 1924, was not nearly as dry as the February of the famous dry year 1921, while March was the driest March over the British Isles as a whole since that of 1900. March presented an unusual feature in that less than 1 in. of rain (and less than 10 per cent. of the average) fell in parts of the western Highlands of Scotland. November was the only other month with less than the average over the country as

a whole. May and September were both extremely wet; May, 1924, being the wettest May since before 1881, and September the wettest September since before 1881 with three exceptions, 1918, 1896 and 1885. In May the fall exceeded twice the average over the greater part of England and Wales, while in September more than twice the average occurred in the south-west of England and Wales, but more notably in the south-eastern half of Ireland. In December the fall over the country as a whole was 127 per cent. of the December average, or as much as 6 in. This was the largest value in inches for any month of 1924. In August more than four times the average fell in the small area affected by the intense fall of the 18th, when at Cannington, near Bridgwater, 9·4 in. was recorded for one day, and at least 8 in. of this amount fell in 5 hours.

Review

Wettervorhersage die Fortschritte der Synoptischen Meteorologie. Von Dr. Walter Georgii. Wissenschaftliche Forschungsberichte. Naturwissenschaftliche Reihe, Band XI., Dresden und Leipzig. Verlag von Theodor Steinkopff, 1924. 4·50 marks.

DURING the last few years very great advances have been made in our knowledge of the dynamics of the atmosphere. The atmosphere as we know it now is a very different atmosphere from the one which we thought we knew twenty years ago. The work of Dines and Shaw in this country, and of Bjerknes, Exner, Sandström and Ficker on the Continent—to mention only a few names—has taught us the importance of the physical constitution of the masses of air, the interplay of which gives us our weather. The results of this new work have been published in a constant stream of original papers appearing in many different journals and magazines and in many different languages, all revolutionising our ideas of the processes which take place in the atmosphere, especially in that part of the atmosphere where cyclones and anticyclones move and have their being. New words have been introduced, and miles of new and unfamiliar formulæ have been written down. Unfortunately some of the new words have not proved successful, and have had to be abandoned or modified. Many of the new ideas are isolated, and several writers have discussed the same phenomenon from different points of view, coming to different conclusions, and only agreeing when they show that our old conceptions were wrong or incomplete. It must be confessed that many of us whose business it is to keep abreast of the progress of meteorology have

at times been bewildered with the mass of new ideas and longed for someone to co-ordinate the results, to separate the corn from the chaff, and to give us a clear idea of where we are going.

In some ways this small book on weather forecasting does achieve this end, if only imperfectly. It is really an attempt to apply the results of this new work to the daily business of forecasting the weather. But too much has been attempted in too small a space. To one who is familiar with the original papers, it is interesting and understandable, but we feel that the ordinary student taking this as his introduction to the practice of weather forecasting will experience not a few difficulties. Still the book is a good book, and contains a wonderful lot in its 111 pages. It will be very welcome, and no one can read it through without getting a general idea of the lines along which progress is being made. We cannot hope to describe the contents of the book in this short review. It must be sufficient to say that Dr. Georgii is an ardent disciple of the Bjerknes school, although he gives a clear account of the opposing theory of cyclone building propounded by Professor Exner. The old method of referring the weather to the form of the isobars now gives place to a critical study of lines of flow and lines of discontinuity. To quote Dr. Georgii: "Although charts of lines of flow will never supersede isobaric charts in practical weather forecasting, they must be placed side by side with them as of at least equal value."

We strongly recommend every one who has a practical interest in meteorology to read this book and then go to the original papers, to which full references are given, when difficulties are encountered. G.C.S.

News in Brief

WE regret to announce the death on January 3rd, 1925, at Borden Wood, Liphook, of Mr. Edmund G. Lamb, who has contributed rainfall observations to the British Rainfall Organization for 25 years (1900-1924). From 1906 to 1910, Mr. Lamb was the Liberal member for the Leominster Division of Herefordshire.

On Sunday, December 21st, Dr. G. C. Simpson, C.B.E., F.R.S., delivered a lecture on *Clouds* at the Guildhouse, London. This formed one of a series of lectures being given at the Guildhouse on Sunday afternoons on *Science in Relation to Life.*

Dr. Simpson has been appointed President of Section A (Mathematics and Physics) for the Southampton meeting of the British Association for the Advancement of Science.

A lecture on the *Measurement of the Pressure of the Wind on Structures* was given by Dr. T. E. Stanton at the Institution of Civil Engineers on December 16th.

On Friday, January 2nd, the Geographical Association held a discussion at the London School of Economics on "The Life of the Fiord Peoples." Mr. J. Fairgrieve gave an account of the present social conditions in Norway, Mr. C. E. P. Brooks discussed the influence of climatic changes during the past three thousand years on the life of the Norwegian peoples, and especially on their seafaring activities, and Dr. A. Sommerfelt read a paper on the economic history of Norway and its effect on present conditions.

According to the *Fruit Grower*, thousands of toy balloons are to be released next spring from fifteen weather stations, extending from northern Connecticut nearly to the Canadian border, in an endeavour to discover the secrets of the winds responsible for the westward spread of the Gypsy moth, which is carried when in the caterpillar stage for distances ranging from half-a-mile to five miles.

The Weather of December, 1924

MILD, unsettled weather with winds between south and south-west prevailed generally throughout the greater part of December. During the first week rain fell on several days and thunderstorms sometimes accompanied by hail, occurred locally, but there were many bright intervals, 6 or 7 hours sunshine being recorded at several stations on the 5th and 6th. Early morning mist and fog were experienced locally, and on the afternoon of the 2nd, intense gloom prevailed in and around London. On the 7th, south and south-easterly breezes caused a drop in the temperature in the south-eastern districts, and, as the anticyclone over central Europe extended westwards, the cold, foggy conditions prevalent on the continent spread also to England. On the 10th and 11th the fog was especially dense, and extended over Germany, France, the Netherlands and England.* In England, maximum temperature readings of below 35° F. were registered at a few stations on both these days; at Wisley and Wallington the maximum reading on the 10th was 32° F. In Ireland and north-west Scotland the mild unsettled weather with south-westerly winds had continued during this time, and after the 12th, when heavy rain occurred in parts of Ireland and Scotland, *e.g.*, 117 mm. (4·62 in.) at Delphi (Mayo), 114 mm. (4·50 in.) at Aasleagh (Mayo), and 50 mm. (1·97 in.) at Achnashellach (Ross-shire), these conditions began to spread again over the whole of the British Isles. High winds and gales were experienced at exposed places on the 13th, and snow and sleet occurred at

* See pp. 277-284.

Oundle and Wisley on the same day. From the 17th to the 22nd there was another spell of drier weather in England (except the west), but, after this, strong winds frequently rising to gale force and heavy rain alternating with bright periods predominated over the whole country until the end of the month. South-westerly winds of about 60 m.p.h. (Beaufort force 10) occurred in the Shetlands on the 25th, and in the English Channel on the 27th, while gusts of over 70 m.p.h. were recorded at a few places on most of the days from the 25th to 31st, *e.g.*, a gust of 90 m.p.h. occurred at Lerwick on the 25th, of 79 m.p.h. at Edinburgh on the 27th and 29th, and of 73 m.p.h. at Shoeburyness on the 31st. Thunderstorms occurred on several occasions, and the rainfall was heavy, especially on the 26th and 29th, when between 63 mm. (2·5 in.) and 89 mm. (3·5 in.) were measured at some stations in the West. Dungeon Ghyll (Westmoreland) had as much as 93 mm. (3·65 in.) on the 26th. Temperature was generally high during the month; maximum readings of over 57° F. were recorded on several days and 60° F. was reached at Colmonell (Ayrshire) on the 23rd. Very little snow was reported until the end of the month, when showers of snow or sleet fell in many parts of Scotland and at a few places in Ireland and England. The total rainfall for the month varied from a little below normal in parts of north-east England (Skegness had only 72 per cent.) to nearly twice the normal in eastern Scotland, where Braemar Bank (Aberdeenshire) had 199 per cent.

Pressure was below normal over Norway, the northern part of the Atlantic Ocean and Spitzbergen and very low over Iceland where the maximum deficit was at Reykjavik, 18·8 mb. There was a large area of high pressure covering central and eastern Europe and extending well into Russia. This pressure distribution was very favourable for strong south-westerly winds over the British Isles and Scandinavia. Temperature was above normal over the whole of Europe, the excess being 11° F. at Spitzbergen, 10° F. at Haparanda, and 2° F. at Lisbon and Zurich. Precipitation was slightly above normal in north-west Europe, but deficient in central Europe. The anticyclone which established itself over west Russia on the 5th spread westwards, and on the 17th had extended to south of the Azores. It remained almost stationary until nearly the end of the month. Over Russia and central Europe there was much fog or mist, but comparatively warm weather over north-west Europe. Depressions alternated with fair intervals during which much fog and some very low temperatures were experienced. Later, conditions became more stormy and there were many gales accompanied by heavy rain. Early in the month bad weather was experienced over the Mediterranean, but the central European anticyclone

brought more stable conditions, and by the 12th fine weather was established. On the 1st, a violent storm swept across Nice and much damage was done. On the 3rd, a storm was felt over the whole peninsula of Spain. From the 8th to the 11th the heavy fog over Belgium and Germany caused serious interruption to rail and shipping traffic. France also suffered from fogs during the month, and, as in England, the last few days were marked by storms on the Atlantic and Channel coasts. In Switzerland, the weather was fine and dry with little snow until the 29th, when the winter sports were able to begin.

Canada and the United States suffered from intense cold in the middle of the mouth. Heavy snowstorms held up railway traffic in west Canada; a temperature of —44° F. was reported from Edmonton in Alberta on the night of the 16th-17th. Schools were closed until the weather moderated. The abnormally cold weather was also felt in all the States west of the Mississippi: at Miles City, Montana, a temperature of —44° F. was reported on the 19th. There was another wave of intense cold over America at the end of the month.

Snow fell in Baghdad on the 26th. This was the first fall for 14 years and was followed by 8° F. of frost. Fog in Japan, on the 12th, was responsible for a shipping accident, when a naval repair ship ran on a reef and 100 seamen were drowned.

Reports from Australia show that there was a deficiency of rain in western Australia and Tasmania, in the latter region only 39 per cent. of the normal amount of rain fell. There was an excess of rain in parts of Queensland and New South Wales. The extreme south-east coast of New South Wales received more than twice the normal (237 per cent.). Elsewhere the rainfall was about normal. There was a storm in Sydney on the 23rd, when a wind of 70 m.p.h. was reported and traffic was seriously affected.

The special message from Brazil states that the rainfall was heavy (113 mm. above normal) in the central districts, and irregular (29 mm. above normal) in the southern districts. Reports from the northern districts are missing. Crops are generally good, except that some of them have been damaged by the excessive rains in the central districts where floods have occurred. At Rio de Janeiro, pressure was 0·7 mb. above normal, and temperature 0·5° F. below normal.

Rainfall—General Distribution

	Dec.	Year	
England and Wales	124	121	per cent. of the average 1881-1915.
Scotland	125	105	
Ireland	140	122	
British Isles	127	117	

Rainfall: December, 1924 England and Wales

CO.	STATION.	In.	mm.	Per-cent. of Av	CO.	STATION.	In.	mm.	Per-cent. of Av.
Lond.	Camden Square.....	3·18	81	133	*War.*	Birminghm, Edgbaston	3·41	87	127
Sur .	Reigate, Hartswood...	4·04	103	135	*Leics*	Leicester Town Hall...	1·51	38	...
Kent.	Tenterden, View Tower	5·00	127	161	,, .	Belvoir Castle.....	2·82	72	115
,, .	Folkestone, Boro. San.	2·99	76	...	*Rut .*	Ridlington.....	2·54	65	...
,, .	Broadstairs	1·53	39	64	*Linc.*	Boston, Skirbeck	1·83	47	85
,, .	Sevenoaks, Speldhurst.	4·11	104	...	,, .	Lincoln, Sessions House	2·21	56	101
Sus .	Patching Farm.....	5·20	132	155	,, .	Skegness, Estate Office.	1·59	41	72
,, .	Eastbourne, Wilm. Sq.	4·60	117	132	,, .	Louth, Westgate	2·50	63	90
,, .	Tottingworth Park....	5·93	151	160	,, .	Brigg	2·00	51	82
Hants	Totland Bay, Aston...	4·09	104	127	*Notts.*	Worksop, Hodsock....	2·25	57	95
,, .	Fordingbridge, Oaklnds	6·24	159	158	*Derby*	Mickleover, Clyde Ho..	2·69	68	102
,, .	Portsmouth, Vic. Park.	4·09	104	131	,, .	Buxton, Devon. Hos...	4·91	125	87
,, .	Ovington Rectory	7·29	185	184	*Ches.*	Runcorn, Weston Pt...	3·09	79	98
,, .	Grayshott	5·68	144	149	,, ..	Nantwich, Dorfold Hall	3·20	81	...
Berks	Wellington College...	3·78	96	131	*Lancs*	Bolton, Queen's Park .	4·77	121	...
,, .	Newbury, Greenham..	5·66	144	177	,, ..	Stonyhurst College....	4·93	125	102
Herts.	Bennington House....	2·98	76	120	,, ..	Southport, Hesketh...	4·31	109	133
Bucks	High Wycombe	4·72	120	161	,, ..	Lancaster, Strathspey.	6·72	171	...
Oxf..	Oxford, Mag. College..	4·17	106	180	*Yorks*	Sedbergh, Akay	11·16	283	190
Nor .	Pitsford, Sedgebrook..	3·45	88	143	,, .	Wath-upon-Dearne ...	1·86	47	78
,, .	Eye, Northolm.....	1·43	36	...	,, .	Bradford, Lister Pk...	4·27	108	128
Beds.	Woburn, Crawley Mill.	3·64	93	154	,, .	Oughtershaw Hall	13·43	341	...
Cam.	Cambridge, Bot. Gdns.	2·29	58	119	,, .	Wetherby, Ribston H..	2·70	69	110
Essex	Chelmsford, CountyLab	2·96	75	...	,, .	Hull, Pearson Park ...	2·25	57	93
,, .	Lexden, Hill House...	2·57	65	...	,, .	Holme-on-Spalding ...	2·65	67	...
Suff .	Hawkedon Rectory ...	2·05	52	85	,, .	Lowthorpe, The Elms.	2·42	61	90
,, .	Haughley House.....	1·71	43	...	,, .	West Witton, Ivy Ho..	5·37	136	...
Norf.	Beccles, Geldeston....	2·35	60	102	,, .	Pickering, Hungate ...	2·14	54	...
,, .	Norwich, Eaton	2·96	75	113	,, .	Middlesbrough	2·64	67	136
,, .	Blakeney	1·58	40	71	,, .	Baldersdale, Hury Res.	5·74	146	140
,, .	Swaffham	2·17	55	91	*Durh.*	Ushaw College	2·66	67	106
Wilts.	Devizes, Highclere....	4·73	120	155	*Nor .*	Newcastle, Town Moor.	2·30	58	95
Dor .	Evershot, Melbury Ho.	7·21	183	140	,, .	Bellingham Manor....	4·25	108	...
,, .	Weymouth, Westham..	4·93	125	142	,, .	Lilburn Tower Gdns...	3·13	79	...
,, .	Shaftesbury, Abbey Ho.	4·85	123	134	*Cumb*	Penrith, Newton Rigg..	...	...	...
Devon	Plymouth, The Hoe...	3·68	93	74	,, .	Carlisle, Scaleby Hall .	4·46	113	139
,, .	Polapit Tamar	7·20	183	141	,, .	Seathwaite	24·50	622	150
,, .	Ashburton, Druid Ho..	10·85	276	144	*Glam.*	Cardiff, Ely P. Stn....	6·47	164	127
,, .	Cullompton	3·73	95	85	,, .	Treherbert, Tynywaun	16·95	431	...
,, .	Sidmouth, Sidmount ..	3·78	96	96	*Carm*	Carmarthen Friary....	9·85	250	172
,, .	Filleigh, Castle Hill ...	6·11	155	...	,, .	Llanwrda, Dolaucothy.	11·45	291	163
,, .	Hartland Abbey.....	5·59	142	...	*Pemb*	Haverfordwest, Portf'd	7·95	202	139
Corn.	Redruth, Trewirgie ...	9·21	234	147	*Card.*	Gogerddan.....	6·73	171	134
,, .	Penzance, Morrab Gdn.	5·92	150	104	,, .	Cardigan, County Sch. .	7·52	191	...
,, .	St. Austell, Trevarna..	6·55	166	108	*Brec .*	Crickhowell, Talymaes	9·00	229	...
Soms	Chewton Mendip	5·54	141	103	*Rad .*	Birm.W.W.Tyrmynydd	9·59	244	117
,, .	Street, Hind Hayes ...	3·33	85	...	*Mont.*	Lake Vyrnwy	8·32	211	121
Glos..	Clifton College	5·72	145	149	*Denb.*	Llangynhafal	3·48	88	...
,, .	Cirencester	5·10	129	148	*Mer .*	Dolgelly, Bryntirion..	7·71	196	113
Here.	Ross, County Obsy. ...	4·03	102	136	*Carn.*	Llandudno	3·95	100	127
,, .	Ledbury, Underdown .	2·83	72	101	,, .	Snowdon, L. Llydaw 9	23·87	606	...
Salop	Church Stretton.....	4·89	124	146	*Ang .*	Holyhead, Salt Island.	4·83	123	116
,, .	Shifnal, Hatton Grange	2·87	73	112	,, .	Lligwy	6·45	164	...
Staff.	Tean, The Heath Ho...	3·01	76	92	*Isle of Man*				
Worc.	Ombersley, Holt Lock.	3·14	80	120		Douglas, Boro' Cem...	6·12	155	122
,, .	Blockley, Upton Wold.	3·31	84	102	*Guernsey*				
War.	Farnborough.....	3·97	101	135		St. Peter Port, Grange.	4·51	114	110

Rainfall: December, 1924: Scotland and Ireland

CO.	STATION	In.	mm.	Per-cent. of Av.	CO.	STATION.	In.	mm.	Per-cent. of Av.
Wigt.	Stoneykirk, Ardwell Ho	4·45	113	109	*Suth.*	Loch More, Achfary...	9·97	253	108
,, .	Pt. William, Monreith .	4·78	121	...	*Caith*	Wick	1·48	38	48
Kirk.	Carsphairn, Shiel.	12·54	319	...	*Ork .*	Pomona, Deerness	2·26	57	54
,, .	Dumfries, Cargen.....	9·42	239	174	*Shet .*	Lerwick	7·75	197	162
Dum	Drumlanrig	8·85	225	169					
Roxb	Branxholme	5·93	151	162	*Cork.*	Caheragh Rectory	10·25	260	...
Selk .	Ettrick Manse.....	12·25	311	...	,, ..	Dunmanway Rectory.	10·67	271	133
Berk.	Marchmont House	3·58	91	127	,, ..	Ballinacurra	6·60	168	129
Hadd	North Berwick Res....	1·68	43	78	,, ..	Glanmire, Lota Lo.	8·11	206	147
Midl	Edinburgh, Roy. Obs..	3·07	78	142	*Kerry*	Valencia Obsy.	9·76	248	147
Lan .	Biggar	4·32	110	128	,, .	Gearahameen	16·70	424	...
Ayr .	Kilmarnock, Agric. C..	4·67	119	109	,, .	Killarney Asylum.....	10·86	276	149
,, .	Girvan, Pinmore.....	6·31	160	105	,, .	Darrynane Abbey	8·87	225	151
Renf.	Glasgow, Queen's Pk..	6·03	153	143	*Wat .*	Waterford, Brook Lo..	6·45	164	138
,, .	Greenock, Prospect H..	11·28	287	143	*Tip .*	Nenagh, Cas. Lough...	8·49	216	184
Bute.	Rothesay, Ardencraig.	7·38	187	135	,, .	Tipperary	5·95	151	...
,, .	Dougarie Lodge	4·67	119	...	,, .	Cashel, Ballinamona ..	5·07	129	117
Arg .	Glen Etive.....	...		...	*Lim .*	Foynes, Coolnanes	7·03	178	149
,, .	Oban	9·22	234	...	,, .	Castleconnell Rec.	7·12	181	...
,, .	Poltalloch	7·80	198	123	*Clare*	Inagh, Mount Callan ..	10·55	268	...
,, .	Inveraray Castle.....	11·51	292	116	,, .	Broadford, Hurdlest'n.	9·12	232	...
,, .	Islay, Eallabus.....	7·83	199	132	*Wexf*	Newtownbarry	6·45	164	...
,, .	Mull, Benmore	15·40	391	...	,, .	Gorey, Courtown Ho...	6·38	162	167
Kinr.	Loch Leven Sluice	5·01	127	127	*Kilk.*	Kilkenny Castle	4·83	123	140
Perth	Loch Dhu	14·00	356	139	*Wic .*	Rathnew, Clonmannon	6·24	159	...
,, ..	Balquhidder, Stronvar.	12·91	328	135	*Carl .*	Hacketstown Rectory .	4·92	125	120
,, ..	Crieff, Strathearn Hyd.	8·38	213	187	*QCo..*	Blandsfort House.....	5·49	139	149
,, ..	Blair Castle Gardens ..	6·36	161	...	,,	Mountmellick	5·81	148	...
,, .	Coupar Angus School..	4·05	103	135	*KCo.*	Birr Castle.....	5·37	136	163
Forf.	Dundee, E. Necropolis.	4·02	102	151	*Dubl.*	Dublin, FitzWm. Sq...	4·43	113	179
,, .	Pearsie House.....	6·43	163	...	,, .	Balbriggan, Ardgillan .	4·30	109	149
,, .	Montrose, Sunnyside..	3·45	88	124	*Me'th*	Drogheda, Mornington	3·90	99	...
Aber.	Braemar Bank	7·10	180	199	*W.M*	Mullingar, Belvedere .	5·65	143	154
,, .	Logie Coldstone Sch. ..	2·56	65	91	*Long*	Castle Forbes Gdns....	5·19	132	130
,, .	Aberdeen, Cranford Ho	3·73	95	107	*Gal .*	Galway, Waterdale ...	...	..	...
,, .	Fyvie Castle	1·74	44	...	,, .	Ballynahinch Castle ..	12·27	312	...
Mor .	Gordon Castle.....	0·94	24	35	*Mayo*	Mallaranny.....	11·58	294	...
,,	Grantown-on-Spey....	1·90	48	70	,, .	Westport House.....	9·80	249	170
Na .	Nairn, Delnies.....	2·38	60	107	,, .	Delphi Lodge	22·22	564	...
Inv..	Ben Alder Lodge	13·68	347	...	*Sligo*	Markree Obsy.	5·38	137	112
,, .	Kingussie, The Birches	4·88	124	...	*Ferm*	Enniskillen, Portora ..	5·09	129	...
,, .	Fort Augustus	...	...	...	*Arm.*	Armagh Obsy.	4·05	103	129
,, .	Loch Quoich, Loan....	25·50	648	...	*Down*	Warrenpoint	3·77	96	...
,, .	Glenquoich	22·77	578	155	,, .	Seaforde	6·30	160	153
,, .	Inverness, Culduthel R.	4·22	107	...	,, .	Donaghadee	2·95	75	93
,, .	Arisaig, Faire-na-Squir	10·08	256	...	,, .	Banbridge, Milltown .	2·29	58	79
,, .	Fort William.....	15·13	384	150	*Antr.*	Belfast, Cavehill Rd. ..	4·77	121	...
,, .	Skye, Dunvegan.....	10·12	257	...	,, .	Glenarm Castle.....	5·54	141	...
,, .	Barra, Castlebay	2·88	73	...	,, .	Ballymena, Harryville	4·91	125	111
R&C	Alness, Ardross Cas. ..	4·45	113	108	*Lon .*	Londonderry, Creggan	4·96	126	113
,, .	Ullapool.....	6·64	169	...	*Tyr .*	Donaghmore	5·94	151	...
,, .	Torridon, Bendamph..	18·21	463	179	,, .	Omagh, Edenfel	4·97	126	118
,, .	L. Carron, Plockton...	...	...	...	*Don .*	Malin Head	5·50	140	164
,, .	Stornoway	9·23	235	148	,, .	Rathmullen.....	5·08	129	...
Suth.	Lairg	2·36	60	...	,, .	Dunfanaghy	7·61	193	147
,, .	Tongue Manse.....	3·28	83	66	,, .	Killybegs, Rockmount.	...	...	...
,, .	Melvich School.....	2·21	56	51					

Climatological Table for the British Empire, July, 1924

STATIONS	PRESSURE		TEMPERATURE							Relative Humidity	Mean Cloud Am'nt	PRECIPITATION			BRIGHT SUNSHINE	
			Absolute		Mean Values				Mean							
	Mean of Day M.S.L.	Diff. from Normal	Max.	Min.	Max.	Min.	½ max. and min.	Diff. from Normal	Wet Bulb.			Am'nt	Diff. from Normal	Days	Hours per day	Percentage of possible.
	mb.	mb.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	%	0—10	mm.	mm.			
London, Kew Obsy.	1012·6	− 3·2	86	45	70·9	53·4	62·1	− 0·6	56·7	70	6·0	95	+ 40	16	7·4	46
Gibraltar	1016·0	− 0·8	91	63	83·2	67·6	75·4	+ 0·6	67·2	68	2·5	0·3	− 1	1	...	...
Malta	1013·7	− 0·3	97	68	85·1	72·8	78·9	+ 1·4	70·5	65	0·9	1	0	1	11·6	81
Sierra Leone	1013·7	+ 0·3	87	69	82·9	71·5	77·2	− 1·8	74·1	83	7·5	745	−131	25	...	...
Lagos, Nigeria	1011·7	− 2·1	87	73	84·2	75·4	79·8	+ 2·5	75·4	77	5·7	63	−206	9	...	...
Kaduna, Nigeria	1015·8	+ 1·8	88	60	83·4	66·5	74·9	+ 1·3	70·9	86	1·5	324	+ 92	22	...	...
Zomba, Nyasaland	1018·8	+ 0·9	76	46	72·0	51·6	61·8	+ 0·1	...	87	5·5	13	+ 6	5	...	...
Salisbury, Rhodesia	1019·9	− 1·0	76	33	70·5	41·8	56·1	0·0	48·5	54	1·3	0	− 1	0	...	...
Cape Town	1021·8	+ 0·5	79	37	63·8	47·3	55·5	+ 0·6	52·1	80	4·2	40	− 50	13	...	...
Johannesburg	1025·5	− 0·2	71	30	60·5	39·8	50·1	− 0·5	37·2	49	1·2	0	− 6	0	9·6	91
Mauritius	1019·8	− 0·6	78	58	74·8	63·3	69·1	+ 0·8	64·6	78	5·8	65	+ 2	21	7·2	65
Bloemfontein	...	...	71	18	61·7	27·3	44·5	− 2·8	33·7	65	1·0	0	− 10	0	...	...
Calcutta, Alipore Obsy.	997·6	− 1·6	93	77	89·5	80·2	84·9	+ 1·4	80·3	89	9·6	264	− 63	*12	...	...
Bombay	1002·0	− 1·7	90	75	85·3	79·0	82·1	+ 1·0	74·6	70	9·5	425	−214	*23	...	...
Madras	1003·6	− 0·9	100	74	95·8	78·4	87·1	− 0·2	76·9	69	7·0	143	+ 39	*10	...	...
Colombo, Ceylon	1008·9	+ 0·8	87	71	85·4	76·4	80·9	− 0·4	77·8	76	8·9	350	+220	24	5·1	41
Hong Kong	1004·1	− 0·8	89	76	86·4	78·4	82·4	− 0·1	77·8	83	7·9	499	+180	23	6·4	48
Sandakan	...	...	93	73	89·1	75·3	82·2	+ 0·3	76·9	78	...	284	+118	18	...	...
Sydney	1023·7	+ 5·2	71	41	63·7	46·7	55·2	+ 2·8	50·0	69	4·1	40	− 83	6	5·8	57
Melbourne	1024·2	+ 5·1	61	33	55·8	41·9	48·9	+ 0·3	46·5	77	5·7	22	− 24	12	4·1	41
Adelaide	1024·7	+ 4·3	69	37	61·8	45·4	53·6	+ 2·0	48·5	70	4·7	16	− 51	12	5·0	50
Perth, W. Australia	1019·7	+ 0·6	74	40	65·5	49·4	57·5	+ 2·4	51·7	67	5·3	96	− 70	16	5·6	55
Coolgardie	1021·7	+ 1·8	74	34	66·0	41·2	53·6	+ 2·4	48·5	49	3·1	8	− 15	3	...	...
Brisbane	1022·5	+ 4·2	77	46	69·3	53·2	61·3	+ 3·0	57·7	74	5·1	135	+ 79	12	6·0	57
Hobart, Tasmania	1019·1	+ 5·3	61	32	52·4	40·2	46·3	+ 0·9	43·0	77	5·6	23	− 31	13	4·0	43
Wellington, N.Z.	1020·8	+ 7·9	61	32	54·3	41·9	48·1	+ 0·6	44·4	75	5·6	75	− 69	14	4·7	49
Suva, Fiji	1014·5	+ 0·3	84	62	78·1	68·4	73·3	− 0·3	68·9	81	6·1	130	+ 13	23	...	...
Apia, Samoa	1010·5	− 1·5	86	70	84·0	74·1	79·0	+ 2·0	75·7	81	5·3	244	+171	20	7·0	61
Kingston, Jamaica	1014·4	− 0·3	93	70	90·3	73·1	81·7	0·0	74·8	67	5·7	33	− 9	8	...	...
Grenada, W.I.	1014·0	+ 0·7	88	70	83·9	74·1	79·0	+ 0·1	75·3	79	5·9	456	+207	22	...	...
Toronto	1014·7	+ 0·6	88	48	77·7	56·9	67·3	− 0·9	60·8	71	3·5	106	+ 29	13	10·0	66
Winnipeg	1013·6	+ 0·9	91	38	77·4	54·7	66·1	− 0·1	62·0	64	4·2	76	− 1	9	9·5	60
St. John, N.B.	1012·1	− 1·6	83	48	69·2	51·7	60·5	+ 0·1	56·1	82	6·0	43	− 49	11	8·2	54
Victoria, B.C.	1017·8	+ 1·1	92	48	68·0	51·7	59·9	− 0·4	53·6	75	3·0	8	− 1	5	10·8	69

* For Indian stations a rain day is a day on which 0·1 in. (2·5 mm.) or more rain has fallen.